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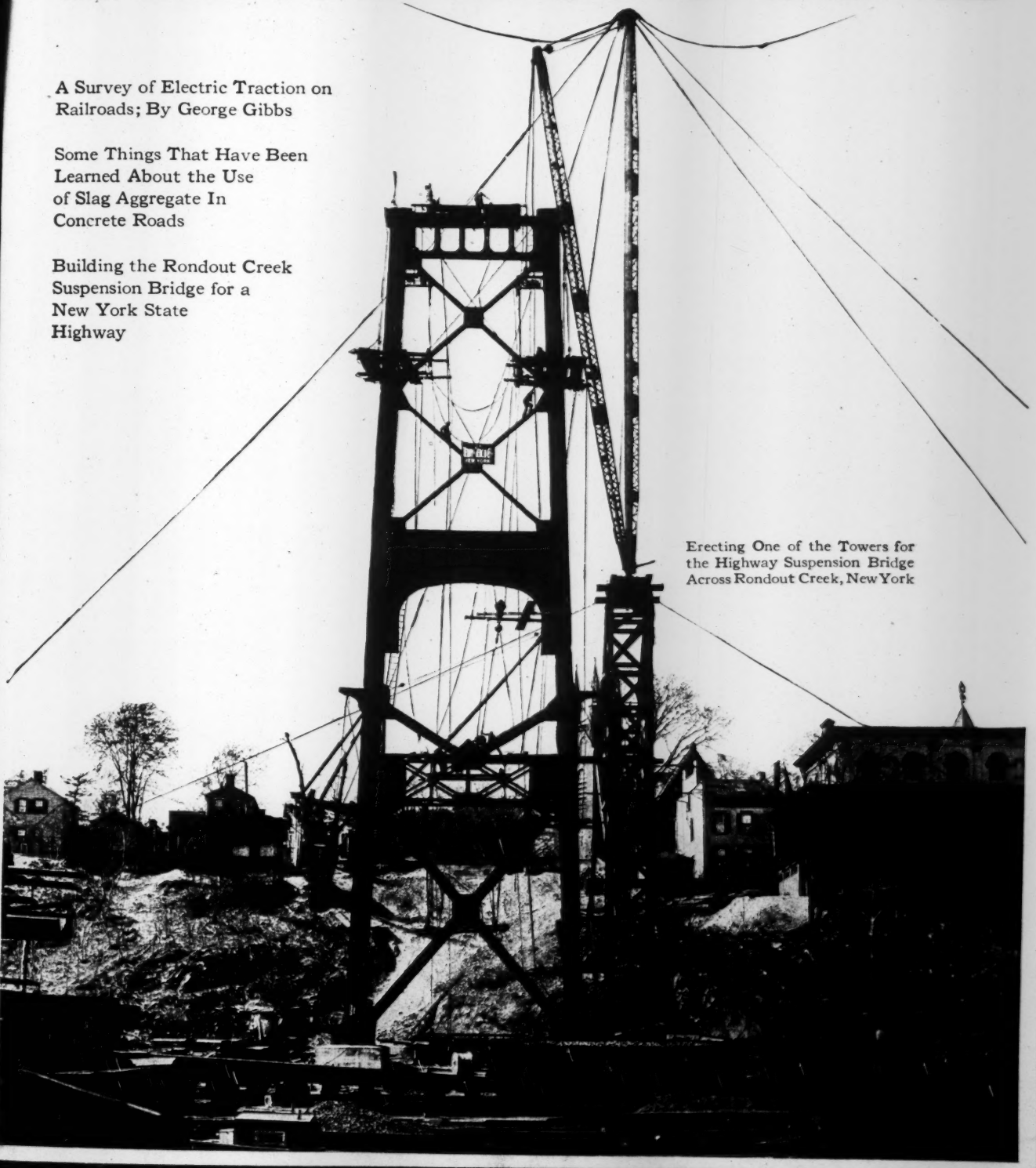
September 14, 1922

Engineering News-Record

A Survey of Electric Traction on Railroads; By George Gibbs

Some Things That Have Been Learned About the Use of Slag Aggregate In Concrete Roads

Building the Rondout Creek Suspension Bridge for a New York State Highway



Erecting One of the Towers for the Highway Suspension Bridge Across Rondout Creek, New York

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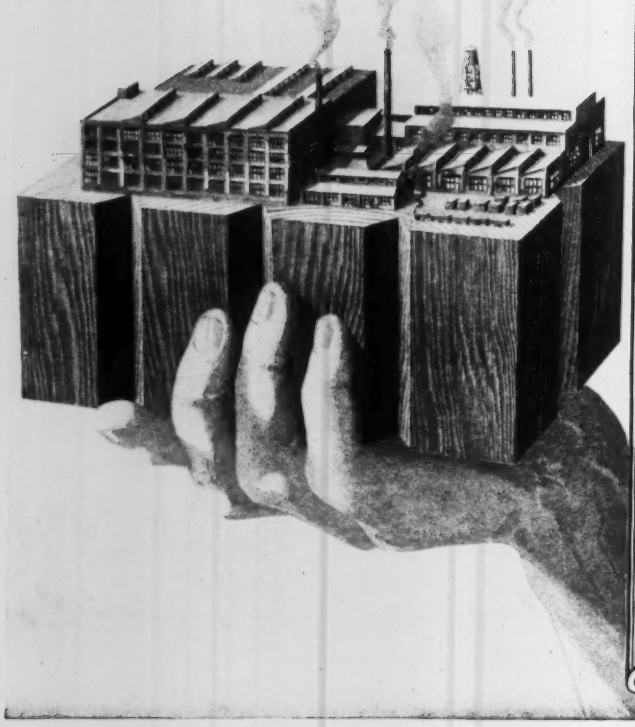

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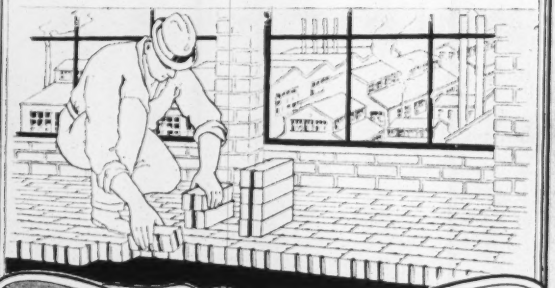

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, SEPTEMBER 14, 1922 — Number 11

Saner Second Thought

AFTER all, we are not to have a general strike. The Gompers' vaporings have not found favor with other labor leaders. And so the country is assured that there will be no general stoppage of enterprise, that it is not to be punished merely because Mr. Gompers felt that the government was not justified in seeking an injunction against the rail strikers. It was our feeling that there would be enough sober thought to counteract the heat of the leader of the American Federation of Labor. The event has proved that such was the case.

The Business Outlook

TESTIMONY comes from many lines of business and industry that if the coal and railway disturbances were out of the way business would go ahead in very active fashion. Past experience in business indicates that their optimism is justified. We have learned that once fundamental conditions are sound, which means that credit is easy and the purchasing power of the country large, even serious industrial disorders have not deflected downward an upward trend in the business curve. How long the present upward progress will continue cannot be, with certainty, foretold. But for the immediate future, six to nine months to be conservative, business prospects promise well. With the coal strikes settled, even though on an economically unsound basis, and the rail strike dwindling away, the outlook is encouraging.

Sewage Relief for Los Angeles

LOS ANGELES is to be congratulated on its large majority vote for a bond issue to build a new outlet sewer to the Pacific and provide treatment works. During the rainy season the new outlet will prevent the flooding that occurs at some points because of the present overcharged outlet. The treatment works are a response to the complaints of the beach cities and their patrons against the fouling of the beaches and adjacent waters. The bond issue was defeated three or four times, but at last it went through with a large majority. Aside from the importance of the favorable vote to Los Angeles and its neighbors it is of interest as preparing the way for the first large sewage-works on the Pacific Coast.

Responsibility for Safe Housing

THERE is a law in Boston which requires the most crowded and most dangerously built types of tenement to be equipped with automatic sprinklers in basement and hallways. A very bad tenement fire some years ago demonstrated the need for at least this minimum of protection to the inhabitants of such tenements—buildings of combustible construction lacking even corridor and stairway protection, and housing ten families or more. Primarily the law seeks to safeguard life, but of course in its ultimate effect it is as much in the interests of the landlord as of the tenant. One might therefore expect to find that it was promptly and cheerfully complied with by the owners. Not so. The owners ignored the law and did nothing about sprinklers. The authorities, with equal inertia, suffered the matter to rest for several years, in fact until last week; now they have instituted court proceedings to compel action. Thus, before a necessary bit of progress toward safety is achieved there is long delay and a struggle—the same unfortunate experience that has attended most other steps in social progress. The trouble arises in part, we think, from the fact that the burden of bringing about an advance is thrown on the government instead of being assumed by the group directly in interest. Safe housing—safe building construction and administration generally—is in every way the concern of the real-estate section of the community in the first instance, and, correspondingly, the promotion and enforcement of progressive regulations should have its source there. Results would be quicker and more effective, at all events, than when the awkward machinery of governmental legislation and enforcement is depended upon. But the real-estate community does not appear to have recognized this obligation and opportunity very fully; certainly not in Boston.

Bridge Loading

AMONG the technical developments of the past week one of the most noteworthy was the discussion of railway bridge loadings which developed at the opening meeting of the American Society of Civil Engineers. It indicated that progress has been made in the direction of clearing up this question, which involves not only bridge safety and economy but also sound engineering procedure. Some weeks ago (July 27, p. 131) we referred to the complex situation in bridge design growing out of the divergence between actual loads and design loads, and to the fact that the standard Cooper loading system is no longer safe to use without arbitrary adjustments for each individual case. Although previous conclusions, chiefly in the American Railway Engineering Association, had reaffirmed the value of the Cooper loadings, a surprising preponderance of opinion at last week's meeting condemned that system as long outgrown. With such views prevailing there is a chance to agree upon a new and better system. But before this problem is taken up it will be well if as much testimony as possible is accumulated on the deficiencies of the old system; a sufficiently broad collection of opinions and experience statements is almost sure to mark out the main lines that a new system should follow. The open forum of the society discussion offers ideal opportunity for the purpose. It will be desirable also to correlate the subject closely with actual stresses. So far as it has gone, the discussion has been based only on calculated results, instead of upon measurements of load effects on bridges. Not many such measurements have been made, unfortu-

nately. However, since strain-gage work by Charles Evan Fowler on the Niagara arch a few years ago showed little change in stress as the engine was moved along, there is a possibility, to say the least, that conclusions based on calculated results may not be of full value.

Aerator Nozzles

IF AERATION can be obtained by the expenditure of 5 ft. of head instead of the usual 10 to 15 ft. it will be far more likely to be considered in future water treatment plants, especially where the water is likely to be infested with odor-producing algae. The single-spray nozzle, the underlying principle of which was accidentally discovered by the engineers at Sacramento (as described in last week's issue of *Engineering News-Record*), answers the low-head requirements and apparently gives the other necessary efficiencies of liberating odors and taking on dissolved oxygen—or liberating the latter if a super-saturated condition exists. The spray produced fits in with the recent thinking of sanitary chemists on the question of getting oxygen into water or sewage in that at all heads it produces a thin gossamer-like sheet. It is this thin double surface sheet, the analysts find, that absorbs oxygen instantaneously. A double surface sheet presents a far more extended area of liquid than do the globular drops from the ordinary spray. The same thought underlies the substitution of mechanical stirring for agitation by compressed air at some activated-sludge plants in England. At those plants aerating paddles give a rotary forward movement to the sewage in long channels, thereby continually presenting new sewage surfaces to the air. Bubbling air through sewage presents globular surfaces of air to the sewage. Per unit the surfaces thus exposed are a minimum compared with the flat surface of spray sheets. While the experiments at Sacramento were mainly for hydraulic results, the chemical and physical changes need as careful study.

Corrosive Waters

THE BANE of many water-works engineers and superintendents is water that corrodes or incrusts metals. These metals form a large part of the investment which it is his duty to conserve and his greater duty to maintain in an efficient condition. In some sections of the country, corrosion is worst where the waters are naturally soft but high in color. Color removal increases the evil. At a few plants in New England mechanical filtration, with prechlorination—the chlorine and alum being introduced simultaneously—produces a non-corrosive low-colored water. To the extent which this combination is available, the engineer and superintendent may chose between water treatment to make the water non-corrosive, a coating to protect the metal and, in the case of pipes, cleaning to remove corrosion. In other words, he has a choice of eradication, protection and amelioration—for cleaning even if complete is only temporary. In practice, the choice may not be simple nor the chosen method so completely as the bald statement in the preceding sentence indicates. Relative costs and perhaps relative efficiencies must be weighed. In some cases, if not most, both eradication and protection may be required; in some, both correction and amelioration; in extreme cases, perhaps all three. A protective coating for all cast-iron and other metal water mains is now, and for all that can be seen will continue to be, in demand.

Designing to Fit the Case

POVERTY is often a spur to excellence in engineering. An illustration to the point is the road improvement described by G. F. Schlesinger in this issue. Here a standard procedure would have been followed without question had the pinch of poverty not diverted attention to other methods. Had there been ample funds and had the construction proceeded in the normal manner the community would probably have possessed as good a road but the engineering would not have been so good. It would not have been an instance of doing well with a dollar what could be done after a fashion by anyone with two dollars. The greater significance to road builders of this operation lies, however, in the emphasis which it lends to the too often neglected doctrine that in reconstructing a highway the original improvement should be capitalized to the greatest possible degree. Incidentally it demonstrates, as a conclusion from the previous statement, that the design of pavement should be made different according to the condition of the old pavement, with a view to obtaining a new pavement of equal strength at all points. This is sound engineering because it is economy as well as the accomplishment of structural unity. The procedure involves no more than a condition survey of the old surfacing and a classifying of the conditions formed into several groups for each of which a standard section of pavement is designed. The article in this issue is of practical value in setting forth a classification and a method of mapping the condition survey.

Closer Relations With Latin-America Through Engineering

IN RIO DE JANEIRO there meets this week an International Engineering Congress, simultaneously with the great exposition and celebration marking the completion of the first 100 years of independence of Brazil from European rule. The Congress, from the standpoint of engineers and manufacturers in the United States, comes at a most opportune time. Just when the engineers and constructors of Latin-America have begun to show a larger appreciation of the characteristics of the engineering and construction methods of the United States, the Congress gives us an opportunity to bring home to Latin Americans the adaptability of our engineering thought to their conditions.

It was quite natural in the past that the engineering thought of Latin America should show in a marked manner the influence of France. Every educated South American speaks French as well as he does his native language. He turns with ease, therefore, to the French technical literature for inspiration and guidance. Moreover, Paris is the Mecca of the Latin world. French engineering thought, as well as French thought in other lines, has naturally had a dominating influence. Of late years, however, while not under-valuating what they have learned from France, the engineers and constructors in our southern hemisphere have come to appreciate that in the development of our far-flung continental territory we have been through the experience with which they, in their equally broad expanses of territory, with sparse population, are now confronted. There has grown apace, therefore, an admiration for our engineering views and methods.

At the Congress now in session in Rio our representatives—and, besides unattached engineers, there will

be present official delegates from each of the four leading national engineering societies—will without a doubt make the best of their opportunity, to the benefit of ourselves, to be sure, but equally, we are confident, of the Latin-American republics.

Back of the engineering significance of the Congress, of course, lies the certainty that a fuller understanding between the engineers of North and South America will have an important influence upon trade development. The political unity of the Americas has long been recognized, to the extent, at least, that we were all of one mind that aggressions from the other side of the Atlantic were not to be tolerated. Commerce, however, knows no commercial bounds and the shrewd traders from overseas, the English and the Germans particularly, were most successful in commercial exploitation south of the Caribbean. We, at the time, were rightfully more concerned with the development of our tremendous domestic market, created by the expansion of our West. Now, however, that we are in a new era, when we have an exportable surplus of finished products, our turn has come to cultivate the buyers of other lands. In this process engineering is the handmaiden of commerce and, by their participation in the Rio discussions, our engineers and constructors must inevitably contribute, no matter how close their concentration upon technical topics, to the strengthening of our commercial relations with Latin-America. Such a strengthening, we need hardly add, is devoutly to be wished.

No Thoroughfare

A PIOUS wish expressed in *Engineering News-Record* recently (July 20, page 90) concerning the desirability of determining the relative importance of land and water traffic at interesting points has unfortunately suffered some misinterpretation, and as it has been circulated with that misinterpretation attached it may mislead some. Another word on the subject may therefore be in order.

Our wish was expressed in connection with two bridge cases where the superior claim of water traffic was in question. One of the cases was that of Newark Bay, where crossed by the main line of the Central Railroad of New Jersey; the city of Newark is opposing the rebuilding of the bridge. Interests supporting the city quoted our wish as being in support of their attitude, and particularly in support of their present endeavor to delay a decision by the War Department on the rebuilding project. Those of our readers who are outside of Newark Bay's five-mile sphere of influence—odoriferous and otherwise—did not, we hope, misunderstand our position so completely, but for the due information of others be it said that we referred in no way to the issues of the Newark case but quite generally to the situation that exists at innumerable points throughout the country as between land and water traffic.

Long-established principle, fixed by tradition rather than by legislation, is that water traffic has the right of way. How this principle works in practice—or rather how unworkable it is—can be appreciated very easily by anyone who will look at a map and note how the country is cut up into little localized strips of land by all sorts of waterways, most of them navigable or potentially navigable. If traffic on each of these little blue lines on the map were actually paramount, as compared with intersecting land traffic, the country could not do business. In view of this perfectly obvious fact it will not be surprising to the map reader that he sees the black lines of railroads cross the little blue lines frequently and in all directions. On the black lines, and on the little faint lines indicating roads (not shown on most maps), depends the whole intercourse between town and town, or state and state. It is they which tie the country together and enable business to go on. Therefore a sort of truce between rail and intersecting water traffic has come into being, administered by the War Department, under which bridge clearances and drawbridge requirements are adjusted.

Under this compromise arrangement, however, water traffic still continues to occupy the favored position, and decisions are made by the War Department which bear no recognizable relation to present or future traffic requirements. All these things mean public loss, or added burden on the community; and the community has burdens enough nowadays. For these reasons we suggested the propriety of a special study of the relative claims of water and land traffic, in order that a more fundamental doctrine as to their relative adjustment at intersecting points could be laid down and the matter thereby removed from its present arbitrary and unsatisfactory basis.

In such adjustment it is not at all impossible that it may be found necessary or desirable to outlaw some of the present "navigable" waters which amount to nothing more than "No Thoroughfare" notices planted across the face of the country. The view has been growing among army engineers themselves, we believe, that in many instances the traditional sanctity of waterways as navigation routes has become very threadbare indeed, because of the continued absence of navigation, and that the old doctrine is irksome even to them as its upholders. Present requirements as to bridge construction, for example, are vague and variable, and in the interest of water navigation development as well as of road and railroad improvement, it would be in the highest degree advantageous to have a specific formulation of the place to be accorded to water transportation and land transportation respectively, where they come into conflict. Fancies of political agitators might then bow to facts.

In expressing the wish that such a statement of principles might be developed, we were particularly careful not to have it relate directly to the Newark case because that city is in a most delicate position with respect to waterways, since it is entrenched behind two notorious "navigable" rivers, at the head of a bay, and itself lies like a barrier across all the lines of communication westward from New York City. However, even at the risk of offending local sensibilities it seems necessary to point out that the study of water and land traffic rights will of necessity, embrace not only rivers, but also coastal indentations, lagoons and bays, unless the efficiency of the entire coastal district is to be sacrificed. It is so obviously illogical to sacrifice the development of great areas of country to the commercial ambitions and speculations of land holders on lagoons and mud flats, or on bodies of water whose shipping possibilities are nothing more than dreams, that the investigation is bound to cover river and coastal indentations alike. Otherwise the No-Thoroughfare aspect of unused "waterways" will continue to give trouble.

Building the Rondout Creek Highway Suspension Bridge

Concrete-Floor Highway Bridge of 705-Ft. Span Constructed by State—Stiffening Trusses Continuous Over Three Spans—Method of Spinning the 9¾-In. Wire Cables—Floor Concreting

By W. E. Joyce and M. Bebarfald

Resident engineers on Rondout Creek Bridge for the New York Highway Commission and for Terry & Tench Co., contractors, respectively; president and vice-president of the W. E. Joyce Co., Inc., engineers, Kingston, N. Y.

With the opening of the Rondout Creek bridge at Kingston, N. Y., this summer, an important link of the state highway along the west side of the Hudson River from New York to Albany was completed. The bridge, shown completed by the view Fig. 1, means a big traffic improvement, as it replaces an antiquated ferry which gave unsatisfactory service. It is a noteworthy innovation in the highway field because it is probably the first and much the most important suspension bridge for highway service built under the modern state highway construction system. Structurally it is important as a demonstration of the adaptability of the suspension principle to relatively short spans for highway traffic.

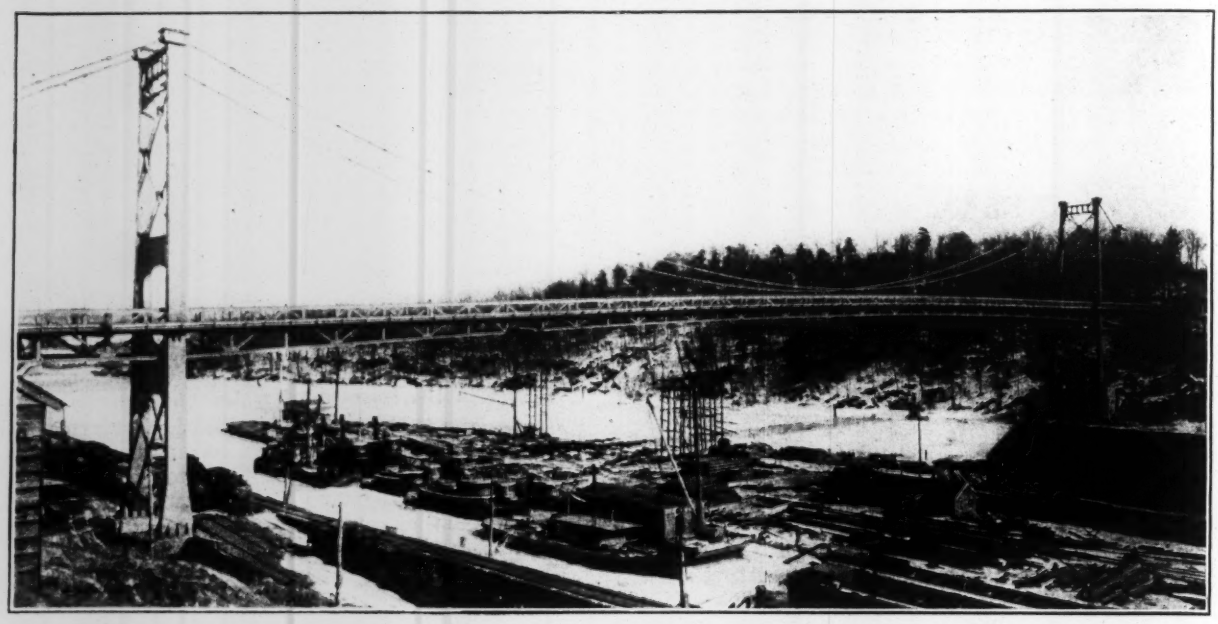


FIG. 1. RONDOUT CREEK CROSSING OF THE MAIN HIGHWAY ALONG THE WEST SIDE OF THE HUDSON RIVER
Main span 705 ft., side spans, 176¼ ft.; two 9¾-in. main cables, supporting a 22-ft. roadway with reinforced-concrete slab deck.

The Rondout Creek bridge is proportioned for the standard heavy highway loading (20-ton truck and 80 lb. per sq.ft.), and because of this and the heavy floor used (reinforced-concrete slab) it is unusually massive, having 9¾-in. and 10¼-in. cables. Its stiffening truss system is unusual as the truss is continuous over the three spans (main span 705 ft., side spans 176 ft. 3 in.). The panel length was kept constant, 17 ft. 7½ in., but the depth of the truss was decreased from 15 ft. at the tower to 10 ft. at mid-span and ends. The trusses and deck are supported by suspenders of 1¼-in. wire rope looped over the cables and connected by adjustable U-bolts to the truss verticals. In the main span each cable contains 1,974 galvanized wires of No. 6 Roebling gage, making the net diameter 9¾ in., while in the side spans 152 wires were added to each cable to take care of the increase in stress caused by their greater inclination to suit the short length of these spans, making the cable diameter 10¼ in. without the wrapping. Direct rock anchorage was available for the cables. The main supports are steel towers 152 ft. high (Fig. 2), resting on concrete piers.

Between trusses the deck, a reinforced-concrete slab 9 in. thick at the crown, is occupied by a 22-ft. roadway; a 7½-ft. concrete sidewalk is bracketed out on either side. The roadway rises southward on a 5 per cent grade from the north anchorage to the center of the bridge and from this point on a 0.2 per cent grade to the south end. This makes the south pier about 18 ft. higher than the north pier.

Illumination of the roadway is provided for by twenty 200-watt lamps spaced about 50 ft., staggered, supported on short standards attached to the top chords of the stiffening trusses. At the south approach there are two 300-watt lamps, and at the north or Kingston end four 300-watt lamps.

Construction Plant Arrangement—Work on the main structure began in August, 1920, but at this time the anchor pits had already been excavated under a prior contract. These pits are shafts cut in the rock to a

depth of about 60 ft. below ground surface; they are 6 ft. in diameter and widen out at the bottom to a chamber 6 x 14 ft. by about 6 ft. high (Fig. 4). The two cables have independent anchor pits. The eyebar anchors are embedded in concrete which fills these shafts, but their upper ends are exposed in chambers formed below the roadway level so that the attachment of the cable strands to the anchors is open to inspection.

Fig. 5 sketches the arrangement of plant for the construction of the bridge. Two stiffleg derricks with 60-ft. booms (*S*1 and *S*2) were erected at the ends of the bridge for placing the anchor steel and the shore-span trusses. Near the tower piers two steel guy derricks with 90-ft. booms (*G*1 and *G*2) were set on timber towers about 100 ft. high, for erecting the steel towers and part of the main-span trusses; derrick *G*1 also served as an unloading and handling derrick. All steel was received by rail and sorted at the base of the north tower, and the material for the south half of the bridge was taken thence by barges to the south pier.

Anchor and Tower Work—Erection of the anchorage material and towers proceeded simultaneously. Each anchor was built of four 24-in. I-beams 12 ft. long, and was connected by a chain of eyebars to the cable shoes. Because of the small size of the shaft the anchorage steel had to be assembled in the shaft. At the angle point in the anchor chain the resultant abutment pressure is taken by a cast-steel shoe against which bear twelve 2 x 21-in. steel pin-plates; the bearing surfaces of plates and castings were machined and lubricated with paraffin to allow for adjustment during construction as the anchorage bars stretched under the application of the dead-load of the structure, and for the same reason the anchor shafts were concreted only up to 8 ft. below the top pin. The full dead-load actually developed a movement of about ¾ in. at the abutment bearing. Subsequently the remainder of the shaft concrete was placed.

The north tower is founded on two independent concrete piers 11 x 16 ft., one under each leg. At the south tower an old pier built under a former contract for a different type of bridge was used, with the addition of two pedestals 16 x 16½ ft. by 8 ft. high.

The tower consists of two legs of box section, battered inward from a spacing of 38 ft. at the base to 27 ft. at the top, anchored to the pier by four 2¼-in. anchor bolts per leg. In fabrication the legs were built in five sections each, the maximum section weighing 22 tons.

Footbridge Construction—The cable saddles are bolted firmly to the tower tops, and any unbalanced pull of the cables produces a bending of the towers. To make the tension in the strand at both sides of the tower equal while the cables were being spun, and thereby prevent creeping of the wires from the main span into the side spans, the towers were deflected to an initial inclination towards the anchorages amounting to 6 in. for the north tower and 5⅜ in. for the south tower, in which positions they were held by a 1¼-in. wire rope from the top of each leg to the anchorage, with a turnbuckle in the rope for adjustment, and also by wedging under the river side of the tower base with steel wedges.

With the towers held in their deflected position, the erection of the footbridge or working platform for the construction of the main cables was started. Six 1¼-in. wire ropes grouped in two sets of three each, spaced 20 ft. 3 in. center to center, were the carrying members of this footbridge. The ropes were socketed at the ends and fastened with U-bolts to a 24-in. I-beam anchored transversely in the center wall of the anchorage, while at the towers they passed over temporary cast-steel saddles bolted to the web of the top portal. They were hauled from the north anchorage to the south by means of a messenger cable running between the stiff-leg derricks and were adjusted to proper sag before the working floor was erected on them. To place this floor, proceeding from the towers outward in either direction, floorbeams 4 x 12 in. x 34 ft. long, which were fitted with U-bolts to grip the ropes, were slid out into the main and side spans and held in position at points corresponding to the final bridge panel points by means of two 3 x 10-in. stringers at each side. On the stringers was built a 6-ft. walk of 2 x 10-in. plank, guard planks and railing. All material was cut, fitted, and matchmarked on the ground, so that the erection of the footbridge was completed in less than two weeks.

FIG. 2. STEEL TOWERS OF SUSPENSION BRIDGE ERECTED BY DERRICKS SET ON WOODEN TOWERS

Cable Spinning—The machinery for constructing the main cables comprised (Fig. 3) a 25-hp. motor geared to a 6-ft. double-grooved drivewheel in front of which was set a 5-ft. idler wheel, at the north anchorage; a guide sheave mounted on the timber frame at either side of either anchorage; an endless cable passing over supports at the tower tops and at the quarter points of the main spans, just over the main cable locations; a trolley frame with grooved wheels fastened at diagonally opposite points of this endless cable; and two reel stands designed to carry three reels of cable wire at each anchorage.

The wire was reeled in lengths of about 70,000 to 80,000 ft. Before the actual stringing of the strands was started, one wire was set in the temporary position of the strand during stringing and accurately set by

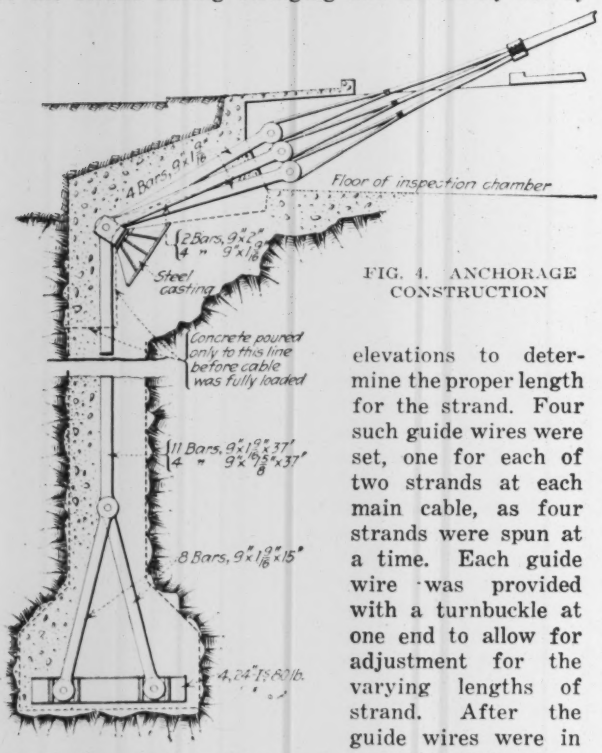

Floor of inspection chamber
Steel casting
Concrete poured only to this line before cable was fully loaded
8 Bars, 9"x1⅞"x15'
4, 24" I's 80 lb.

FIG. 4. ANCHORAGE CONSTRUCTION

elevations to determine the proper length for the strand. Four such guide wires were set, one for each of two strands at each main cable, as four strands were spun at a time. Each guide wire was provided with a turnbuckle at one end to allow for adjustment for the varying lengths of strand. After the guide wires were in position the spinning of a strand (containing 282 wires) was started, each wire being adjusted to correspond in sag to the guide wire. The strand wires were carried temporarily in deep grooved sheaves at the towers about 15 in. above the main saddles, so that the temporary position of the strand was parallel to its final position and 15 in. higher (Fig. 6).

In detail the spinning operation was as follows: The

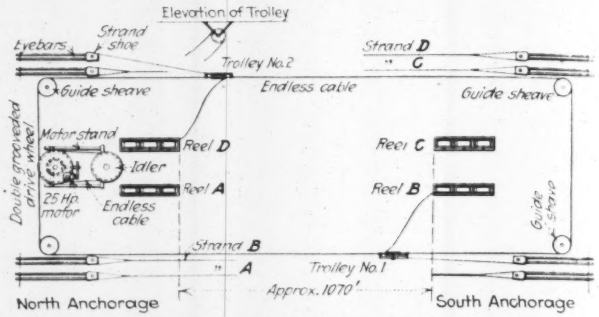


FIG. 3. DIAGRAM OF CABLE-SPINNING PLANT

end of the wire from reel *D*, Fig. 3, was secured to a strand shoe mounted on a casting held between a pair of anchorage eyebars, and the bight of the wire was passed over trolley No. 2; similarly the wire from reel *B* at the south anchorage was passed over trolley No. 1. The motor then carried the endless cable around so that trolley No. 1 moved from the south anchorage to the north, and trolley No. 2 in the opposite direction. When each had reached the other end, the bight of wire was removed from either trolley and passed around and clamped to a strand shoe, held on a pair of anchorage eyebars as at the opposite end. Then trolley No. 1 was loaded with wire from reel *A*, and trolley No. 2 with wire from reel *C*, the driving motor was reversed, and the trolleys with their wire again moved across the valley. Men stationed at the towers, at the centers of the main and side spans, and at the anchorages, adjusted the wires to the sag of the guide wires.

Thus each round trip of one trolley put in place four wires, and as two trolleys were in operation eight wires were placed on a round trip. When 282 wires were strung in each of the four strands under way at one time, they were squeezed together with hand squeezers, seized temporarily every 4 ft. with wire seizing, and the strands then picked up by a 10-ton chain block on the gallows frame over the tower top, lowered to the main cable saddle, and adjusted to proper sag in each span.

At each anchorage a 12-ton hydraulic jack was used for holding the strand shoe back in position while it was being lowered by the stiff-leg derrick to its vertical position between the eyebar heads and pinned in place, and also for adjusting the strand to final sag. The strand was made slightly longer than its calculated length, and the adjustment was accomplished by setting shim plates between the pin block and the strand shoe.

The four extra strands in the side spans were spun by a similar process, except that the trolley ran only to the main tower.

All the wire as received was not as uniformly straight

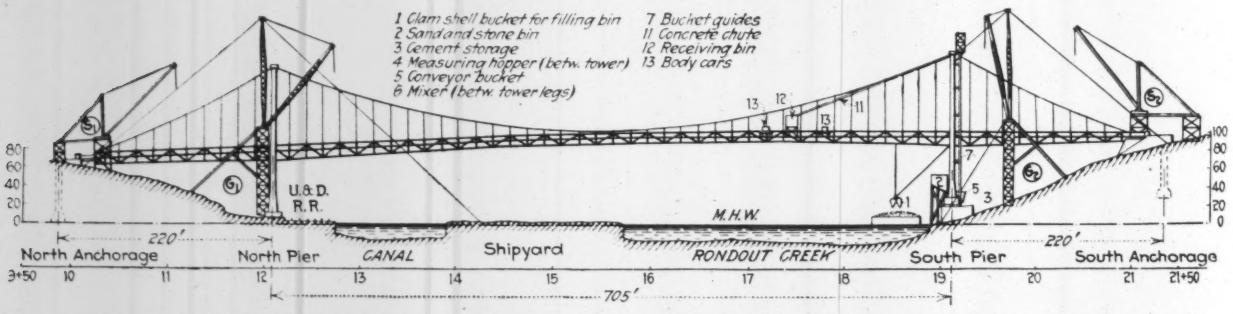


FIG. 5—PLANT LAYOUT FOR STEEL ERECTION AND CONCRETE DECK CONSTRUCTION, RONDOUT CREEK BRIDGE

as would have been desired. To provide for the wavy condition which tended to result from stringing wire that was deficient in straightness, allowance was made in setting the individual wires to the elevation of the guide wires. Wherever a sharp kink occurred in the wire it was cut out, the ends of the wire were threaded and a sleeve splice was inserted, before continuing the stringing. No trouble resulted other than momentary delay.

When all the wires were strung, the temporary seizings of the strands were removed, petroleum grease was

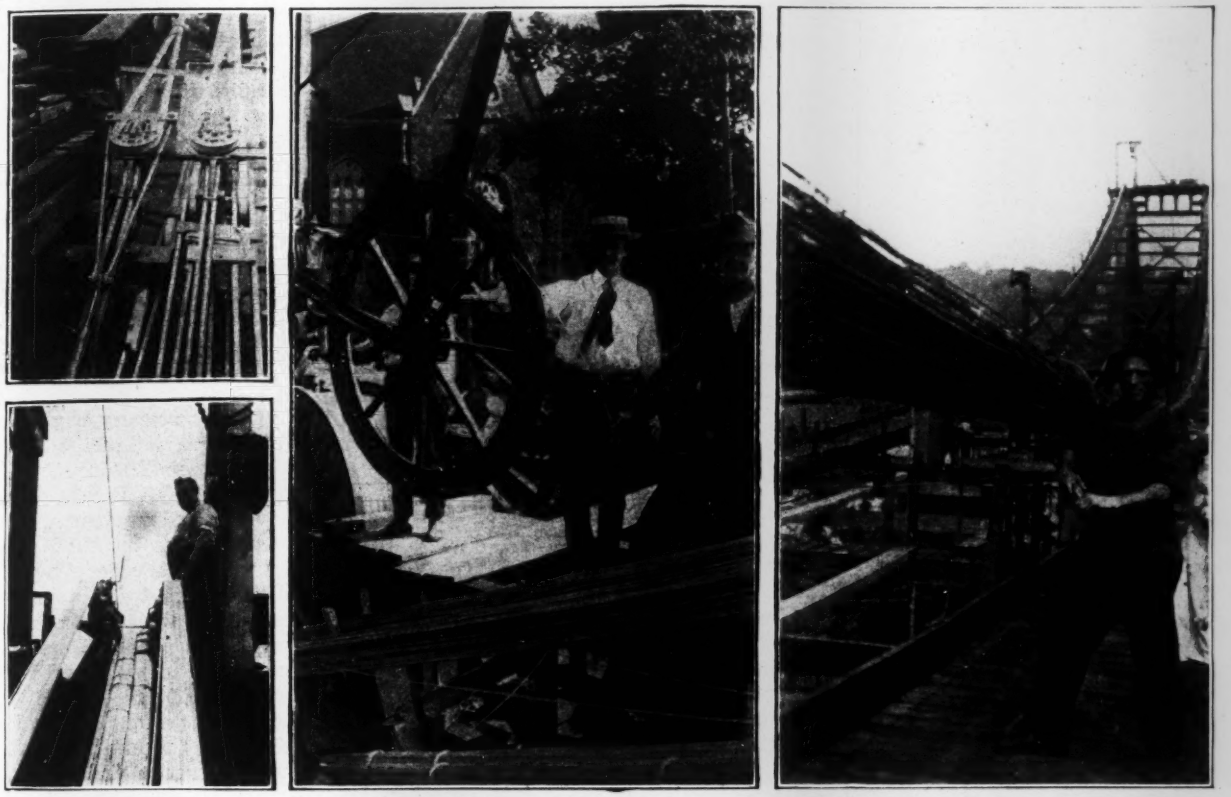


FIG. 6. CABLE-SPINNING OPERATIONS ON THE RONDOUT CREEK BRIDGE

Strand shoes at one of the anchorages in temporary position for the spinning of a strand, with jacks attached for adjustment—Trolley wheel for spinning main cable wire, starting a trip across the span—Cables at saddles, showing strands in temporary and final positions—Squeezing the strand wires into the complete cable.

slushed between the individual wires, and the cable was squeezed by a hand squeezer to the required diameter and again held by wire seizings placed about 2½ ft. apart.

Suspenders—The position of the cable bands was computed and marked on the cable, and the bands placed and bolted into position. It was then possible to lash the footbridge to the cable bands and remove the footbridge ropes. These ropes, cut up into proper lengths, were used for the suspenders; they were socketed and placed in position over the cable ready to have the stiffening trusses attached to them.

Truss Erection—The side trusses were erected on timber falsework, set to grade and riveted while the cable was being squeezed and the cable bands were being put in position, in order to expedite the work. The main-span truss erection, however, could begin only after the suspenders were in place.

The first four panels of these trusses were erected by means of steel guyed derrick at the tower, but the remainder were erected in part by a traveler moved ahead on the stringers as each succeeding panel was erected, and in part by runner tackle hung from the cables. Because of the sensitiveness of the cables to local loading, and the relatively large weight of the floor travelers, it was found expedient when approaching the center of the span to bring the travelers back to the towers and use them as stationary hoists, handling the rest of the floor steel by runner lines suspended from the main cables.

After the complete erection of the stiffening trusses in the main span, the bottom chords and the floor system as well as the wind chords were fitted up and riveted. The rest of the riveting, however, was postponed until the full weight of the concrete roadway and sidewalk was imposed, in order to bring the truss to line and grade.

Concrete—Plant for the floor-slab concreting was laid out as indicated in Fig. 5. The sand and stone were received most economically by barge, and for this reason there was erected at the south tower a bin with a capacity of 60 yd. of sand and 50 yd. of stone. A clamshell bucket rigged to the floor system of the bridge hoisted the material from the barge to this bin, where a measuring hopper discharged into a half-yard mixer, which in turn discharged into a hoist bucket. The latter traveled on guides to the top of the steel tower and there discharged into a chute which carried the concrete to a bin on the bridge floor, where bucket cars running on tracks and operated by cables from the hoists at the towers delivered the concrete.

Later, when the sidewalks were poured, the volume and area did not warrant continuing this elaborate plant in use, and the work was taken care of by a one-bag mixer using material stored at points on the bridge deck.

A traveling scaffold designed to operate on the wind chords of the main span served for placing, stripping and removing the deck forms.

Wrapping—After the full load was on the main cables, they were finished by wrapping with No. 9 galvanized wire. The wrapping machine carried two bobbins, each holding about 200 lb. of the wrapping wire, and was rotated about the cable by a 1½-hp. motor carried on saddles resting on the cables and held against transverse movement by a frame supported on the cable bands. The wire was fed off the two bobbins and wrapped around the cable under the pressure of a shoe which, due to a lip on its bearing surface, served to slide the motor carriage along the cable. On an average about three panels of cable were wrapped per 8-hr. day.

FIG 7. STEEL ERECTION IN MAIN AND SHORE SPANS
Distortion of stiffening trusses in main span corresponds to the absence of the weight of the concrete deck at this stage—In view at right, the derrick is building the wooden falsework for carrying the side-span trusses.

Finally, the footbridge was removed and the trusses were adjusted to final grade by means of the U-bolts connecting the trusses to the suspenders. All structural steel was given a field coat of red lead paint and two finishing coats of battleship gray, having previously received two shop coats.

Personnel—The bridge was built for the New York State Highway Commission. It was begun under the administration of Frederick Stuart Greene as Commissioner, and was completed under Herbert S. Sisson, Commissioner, and Fred W. Sarr, First Deputy. The plans and specifications were prepared by Daniel E. Moran and William H. Yates, consulting engineers, New York City. The Terry & Tench Co. was the general contractor. Charles Michaud, of Kingston, was sub-contractor for the concrete piers and anchorages.

The writers were resident engineers for the State Highway Commission and for Terry & Tench respectively. B. I. Hall was assistant engineer for the commission. For the contractor, H. D. Robinson was consulting engineer, W. D. Jordan engineer in charge, and A. Spooner superintendent.

Utilizing Existing Road Metal in New Construction

Detail Surveys Determine Usable Material—Three Conditions of Old Road Classified—Different Section for Each

By G. F. Schlesinger
Consulting Engineer, Columbus, Ohio

A CONDITION survey of an old macadam road in which the findings were plotted in detail enabled a considerable part of the original structure to be utilized. With an equally careful study in the substitution of local materials this survey enabled a high class improvement to be carried through at a moderate cost. Without extreme detail, which naturally will vary with different improvements, this article considers: (1) The methods employed in surveying and planning to insure the saving and utilization of the existing road metal in the construction of the proposed pavement and (2) the use of local material deposits in the construction and design of the pavement.

The improvement was 5,409 miles of Intercounty Highway No. 30, a portion of the main route between Cincinnati and Portsmouth, O. It was originally a traffic-bound macadam. In many places the old structure was in excellent repair and well suited for a foundation for a modern surfacing. There were also a number of places where the bottom had dropped out and the road was practically impassable in bad weather. The original plan contemplated two types of pavement, bituminous macadam and waterbound macadam 16 ft. wide, with a uniform thickness of 11 in. the entire length. This was in line with the usual practice and did not take into consideration the varying conditions of the original road nor the possibilities of utilizing the existing road metal in the proposed construction. The estimates placed the cost of waterbound macadam at $166,080 and of bituminous macadam at $182,362, but no bids were obtained. A stone which met the specifications could not be had short of a rail shipment of 100 miles which brought the cost to $3.33 per ton.

Attention was then turned to the use of a local bar gravel and boulders which had come to notice and as the result of the study it was decided to use gravel with the provision that "gravel shall be taken to mean a mixture of crushed and uncrushed boulders mixed with fine gravel—not less than 65 per cent of the material shall be crushed boulders." With a source of cheap material provided a study was made of how to reduce cost by utilizing as far as practicable the old surfacing.

It was decided to make a detailed investigation of the road metal then in place, with a view of using it in the base course of the proposed construction. The existing macadam was located in the field with reference to the proposed center line at every station and at intermediate points when necessary, and its condition was determined

and noted. The existing condition was classified as follows:

A Condition, where the present macadam could be used for base course without addition of new material.

B Condition, where the present macadam could be used for base course by filling ruts and depressions and bringing it up to the required shape and elevation with gravel, all such additional gravel to be rolled in place. The entire area of *B* sections required an average depth of 3 in. after being rolled.

C Condition, where an entire base course of new gravel would be required; depth, 6 in.

Of course the limits of the existing road metal did not coincide with the edges of the proposed pavement, and where *A* and *B* conditions existed a base course of new waterbound gravel 6 in. deep was required to fill the space between the outside line of the old macadam and the outside line of the proposed pavement.

The location and condition of the existing macadam pavement was shown on a diagram to a longitudinal scale of 1 in. = 100 ft., and to a lateral scale of 1 in. = 10 ft. (See Fig. 1). The area of the existing pavement, classified into the three conditions, was measured from this diagram. The typical pavement section adopted provided a base course of 6 in. of waterbound gravel, an intermediate course of 5 in. of waterbound gravel, and a top course of 3 in- bituminous macadam. (See Fig. 2). The top course of bituminous macadam was to be built according to standard specifications, for which it would probably be necessary to ship in the limestone aggregate. In locating the proposed profile line it was necessary to avoid cutting into the existing road metal where it was worth saving, that is, where *A* or *B* conditions obtained. The condition and location of the existing macadam was also indicated on the cross sections. Of course the quantity and character of new construction required for the base course varied in accordance with the condition of the old macadam. The items appearing in the new estimate under "Pavement" were as follows:

31,082 sq.yd. waterbound gravel base course, 6 in. depth
14,006 " " " " " " 3 in. ave. depth
52,203 " " " " second " 5 in. depth
52,203 " " bituminous macadam top course, 2½ gal. bituminous material per square yard
1,000 " " extra waterbound gravel base course, 6 in. depth at locations to be designated by the Commissioner

The items of extra waterbound gravel base course was to take care of inaccuracies in the field investigation. The engineer's estimate on the revised plan was $183,629 for asphalt macadam, and $176,408.70 for tar macadam. Bids were received April 4, 1921, and the contract was awarded to the T. D. Van Camp Co., of Columbus and Cincinnati, on tar macadam at their bid of $169,757.07. The base and second courses were completed in 1921, and the bituminous macadam top course is now being constructed, using shipped stone.

The equipment used consisted of two jaw crushers, 150 tons daily capacity each, installed on Nine Mile Creek, about 1¼ miles from the road, two rollers, two stone spreaders and an average of 15 trucks and 10 teams hauling material. The local stone was crushed to a maximum size of about 5 in. and contained 8 to 10 per cent clay and silt. In order to increase progress the contractor was given permission to "sledge" a portion of the stone, and probably a third of the base course was constructed of hand broken material. The construction has resulted in a base course of excellent quality comparable in every way to a waterbound macadam constructed with separated aggregate and screenings. The road was open to traffic during the winter and spring months, and at no point were ruts or depressions of any material depth formed, although the truck traffic in this territory tributary to Cincinnati is heavy.

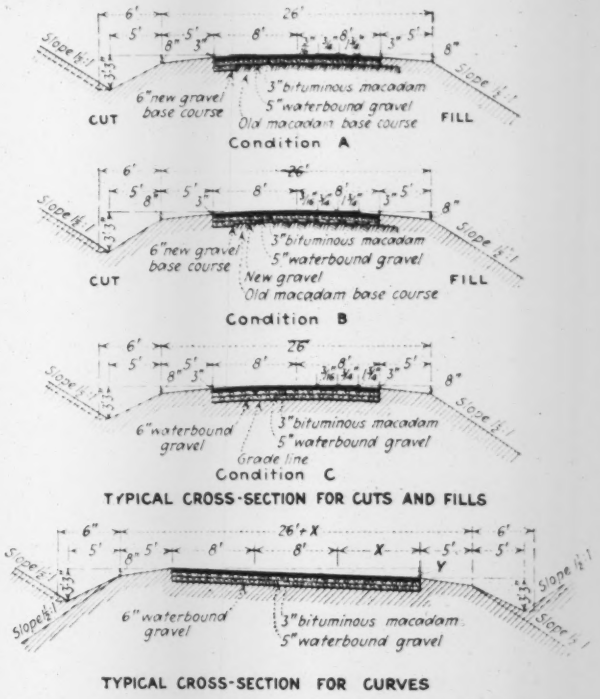


FIG. 2. CROSS-SECTIONS FOR DIFFERENT CONDITIONS OF OLD ROAD

It is believed that in many similar cases of road design, time and money spent in a detailed survey and investigation of existing conditions and in the consequent preparation of plans would be warranted many times by the resulting economy in construction. To lay a profile line that will require the excavation of road metal already bound in place by years of traffic, in order to balance cuts and fills is in most cases an economic waste no matter what the type of pavement proposed.

The survey and plans were made by J. A. Lilly, resident engineer, under the direction of G. F. Schlesinger,

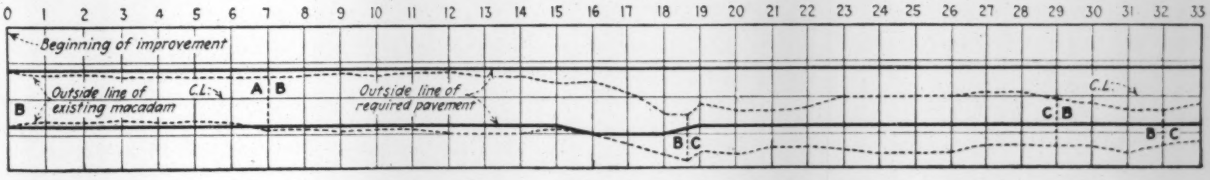

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
Beginning of improvement
Outside line of existing macadam
C.L.
Outside line of required pavement

FIG. 1. CONDITION PLOT OF EXISTING MACADAM ROAD

division engineer. A. R. Taylor was State Highway Commissioner of Ohio. The contract was let by Leon C. Herrick, present Director of Highways and Public Works. The construction has been principally under the direction of E. R. Justice, resident engineer and W. W. Fisher, division engineer. Federal aid was used to finance the improvement, it being known as Federal Aid Project No. 151. W. M. Wilbur, chief of the Ohio office of the Bureau of Public Roads, approved the plans and inspected the construction for the Federal Government.

Pollution of Water from Deep Well

AN UNUSUAL case of pollution of water from a deep well is reported by C. M. Baker, state sanitary engineer of Wisconsin, in the report of the Wisconsin Department of Engineering for the quarter ended June 30, 1922. Mr. Baker says:

An investigation at Fond du Lac was of special interest because by especial tests it was demonstrated that there was a leak in the casing of one of the wells; also that pollution could find its way into the water through the exhaust of the air-lift and booster used to pump the water from the well and force it into the storage reservoir. The booster and air-lift are located below the surface of the street in a pit provided with concrete walls. To determine whether there were leaks in the outer casing of the well, arrangements were made whereby air could be forced into the space between the outer casing and the air lift under pressure. This test disclosed two very pronounced leaks where the booster is connected with the well casing. Further observations disclosed the fact that when the air lift was started in operation there was a distinct suction through these leaks or openings, this probably being due to the lowering of the water level in the well during the pumping. The exhaust from the booster had been connected to the storm sewer in order to eliminate the noise of the exhaust which was objectionable in the neighborhood. This exhaust pipe was disconnected and dropped into a barrel partly filled with water. Forty minutes after shutting off the air lifts of the well the water was syphoned out of the barrel back into the bell or drum of the booster, thus demonstrating conclusively the possibility of pollution finding its way into the well in this manner.

An English Railway of 15-in. Gage

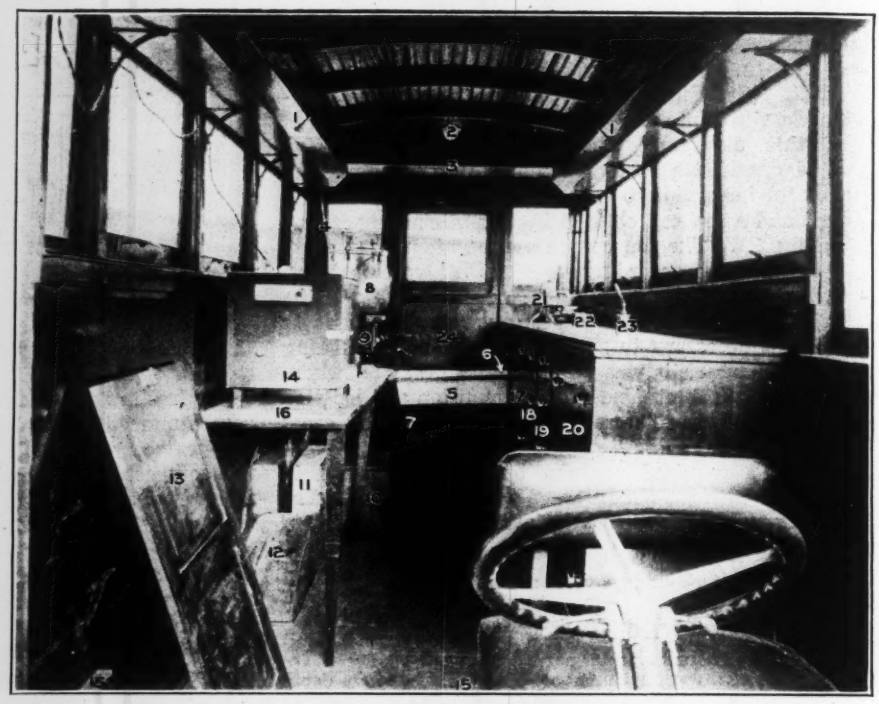
A miniature railway handling regular passenger, mail and freight traffic is the Eskdale & Ravenglass Ry. in England, a 7-mile line of 15-in. gage connecting with the Furness Ry. at Ravenglass. The closed passenger cars of the compartment type are about 5 ft. high and seat two passengers in each of the four compartments.

Motorized Laboratory for Resort Sanitation Work

Michigan Department of Health Spends $5,000 Annually to Protect the $100,000,000 Summer Resort Business

BY W. C. BROCKWAY AND GEORGE C. STUCKY
Assistant Engineer, Bacteriologist,
Michigan State Board of Health, Lansing, Mich.

PROTECTING the health of pleasure seekers from June to October is protecting the fourth largest industry in Michigan. Boasting 15,000 miles of improved highways, half a hundred camp sites provided for the traveling public by the state, 5,176 lakes, a network of rivers and small streams, virgin forests and 1,624 miles of shore line, Michigan is advertised as the "Nation's Summer Playground" by both resort owners and their patrons.



INTERIOR OF MICHIGAN MOTORIZED LABORATORY

1—Cases for light miscellaneous articles. 2—Dome lights, two. 3—Copper water tank, 20 gal. capacity. 4—Hose from water tank to sink. 5—Sink; folds into space at right. 6—Sink hinges. 7—Sink outlet; hose through floor to ground. 8—Pressure cooker used as autoclave. 9—Kerosene stove. 10—Oven for dry heat fertilizer. 11—Dish pan. 12—Wheel housing. 13—Removable door from sink cupboard. 14—Incubator, Eberbach, 12 x 12 x 12 in., inside dimensions; runs from local light circuit or from storage battery of car. 15—Cleats for extra seat. Capacity of seats, four people. 16—Folding work bench. 17—Cupboard for sterilizer and other articles. 18, 19 and 20—Stack of drawers. 21—Folding microscope. 22—Microscope lamp. 23—Gasoline Bunsen burner. 24—Rear door.

It is good business for Michigan to "deliver the wares" it advertises, since each summer at least $100,000,000 is spent in the state by vacationists who go to the country or to the lake and river resorts. To help safeguard these vacationists from avoidable diseases is recognized by the Michigan Department of Health as one of its duties. It is therefore spending about $5,000 annually on a motorized laboratory for resort work alone.

In 1913 one representative of the department inspected 77 resorts in the southern part of the Lower Peninsula. Seven men in 1916 inspected 173 resorts

in 29 counties. In 1917 one inspector visited 48 resorts in 15 counties. Common carriers were used for transportation.

Reason for Motorized Laboratory—It was concluded early in 1920 that travel by train and a hurried inspection without comprehensive testing of water or investigation of food supplies did not give the tourists and resorts the attention they were entitled to and fell far short of accomplishing all that we desired. Train travel was expensive, involving livery hire to reach isolated resorts and considerable time in waiting for transportation and making connections. Further, very little educational literature could be carried for distribution.

Trained men equipped with a portable laboratory for making examinations of water and food supplies was the best means of looking after summer resort sanitation, officials of the department concluded. The laboratory could be set up at a central point in a group of resorts. Then from such a location inspection trips could be made with a passenger car carrying literature and water sample bottles necessary for the individual inspection trips.

Specifications—Accordingly the motorized laboratory was designed and equipped under the joint supervision of the directors of the Bureaus of Engineering, Laboratories and Communicable Diseases. The aim in planning the car was to provide for all of the required equipment in as limited a space as possible, having only as much working space as would be required by two laboratory workers.

The car consists of a stock chassis on which is mounted a bus body 12 ft. long, 5 ft. wide and 6½ ft. high. This is a standard design except that the height is increased 6 in. to insure ample head room.

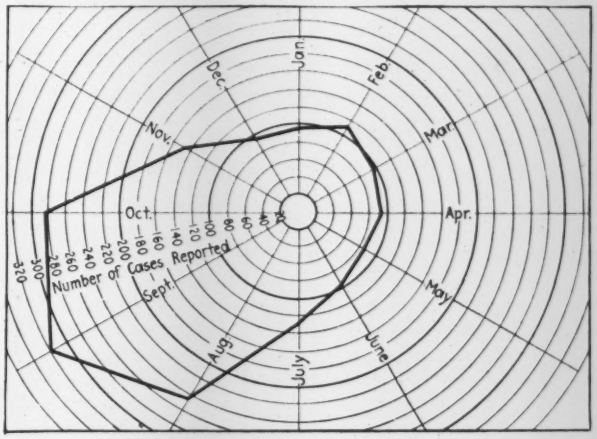
Laboratory equipment consists of the necessary glassware to make bacterial examinations of water in accordance with "A.P.H.A. Standard Methods." There is also included a kerosene stove, a dry-heat oven, an autoclave, a 37-deg. incubator, a Lorenz milk tester, a water storage tank, a sink and a supply of bottles for collecting water and milk samples and for holding media and chemicals. Supplies of bulletins on sanitation are carried for distribution. The bulletins treat of various public health subjects, including water supply, sewage disposal, sanitary privies, chemical closets and fly and mosquito control. Placards on resort sanitation and fly and mosquito control are included. A roadster supplements the motor truck. A 9 x 9-ft. officer's wall tent, folding army cots and a blanket roll are carried for use in case suitable hotel accommodations cannot be found.

In 1920 the personnel consisted of a sanitary engineer, a bacteriologist and a driver. In 1921 the staff consisted of a sanitary engineer (for sanitary surveys), a bacteriologist, who had been in the employ of the department long enough to become thoroughly familiar with its practices and policies, and two food and milk specialists.

Field Work—The truck was located at a suitable central point in a group of resorts. The bacteriologist was left with the laboratory to carry out analyses and to interview people interested in public health work who visited the truck. Other members of the unit visited nearby resorts and made inspections. Resorts as far as 40 miles from the truck were sometimes visited in the roadster. It was advantageous for the laboratory to be moved as infrequently as possible. This condition had to be balanced with the necessity of keeping within easy distance of the resorts to be visited.

The laboratory was always located in a conspicuous place to encourage visitors and facilitate educational work. Technic and methods of analyses were explained and various questions of public health discussed. Talks were also given to various groups, such as clubs, city councils and resort-governing organizations.

Publicity was considered important. Nearly every community visited had a newspaper and these were



SEASONAL PREVALENCE OF TYPHOID FEVER IN MICHIGAN

Chart shows average number of cases reported each month for the years 1808 to 1919 inclusive.

made use of in every instance. Most editors preferred to receive articles ready for publication, since the subjects treated were of a semi-technical nature. This work was done by the men in the field, and articles on the general feaures of public health and on the experiences and the information collected concerning local conditions were prepared.

Rating Resorts—An agreement had been reached in June, 1921, between Dr. R. M. Olin, commissioner of health, and Hugh Gray, secretary of the Michigan Tourist and Resort Association, which provided that resorts inspected should be rated according to sanitary conditions and that such ratings should be published so as to make the resorts comply more fully with the principles of sanitation recommended by the Michigan Department of Health. Resorts were classed as A, B, C or D, indicating excellent, satisfactory, dangerous or unsafe conditions. Ratings were based on the character of the water, food and milk supplies, the sewage and garbage disposal service, housing conditions, bathing beach sanitation, drainage, mosquito control and general conditions of premises and grounds.

Work Done—In 1920 the three men with the motorized laboratory and roadster visited 59 resorts in 12 counties. Of 168 water analyses, 48 per cent indicated safe and 52 per cent unsafe supplies. Five resorts, or 8 per cent, were found to be in excellent sanitary condition, 21 resorts, or 35 per cent, were in poor sanitary condition. In 1921 the four men working in ten counties inspected 123 resorts and hotels and made reinspections of 33. Thirty-two resorts were given a Class A rating, 75 a Class B, 15 a Class C and only 1 a Class D rating.

Outstanding Conditions at Resorts—Among the most

prominent defects discovered at resorts inspected are: Lack of resort government; absence of food and milk control; no control of water supplies; lack of sewage disposal; stream and lake pollution; insanitary outdoor privies; imperfect garbage disposal. Some adequate governing organization seems to be the outstanding need at resorts. Often the resorts are closely built up and densely populated. Dwellings are frequently occupied by more people than commonly occupy dwellings of the same size in cities. Hotels are usually crowded during the rush season. Dealers in food stuffs do a thriving business and sometimes are poorly equipped for conducting such business carefully. A majority of the people coming to resorts are from large cities where water and food supplies are carefully guarded so that they give little or no thought to such utilities at the resorts.

Without an efficient governing organization it cannot be expected that these conditions will be properly controlled. They offer opportunities for the careless and dishonest dealer in foodstuffs. Water supplies in thickly populated districts are almost certain to become dangerous unless given proper protection. The temporary nature and overcrowded conditions at most resorts would seem to call for the most careful supervision. When it is considered that many of the patrons at the resorts are persons in a state of impaired health, the dangers are increased.

Many instances of stream and lake pollution were found that were not only nuisances but also endangered bathing beaches and detracted from the desirable features of lake fronts.

Milk supplies, especially those inspected in 1921, were found to be poor in many cases. Work done to improve them was of great value. Few laboratory analyses were made because they were considered unnecessary due to the fact that the milk was produced and handled carelessly and under insanitary conditions.

The attached typhoid curve indicated a relation between high typhoid rates in the late summer and early fall and the insanitary conditions found in summer resorts. One large city in the state claims that 50 per cent of its typhoid is brought from summer resorts.

Since the Michigan Department of Health cannot do all that is desirable, it strongly recommends that resort associations be formed to retain technical advisers to assist their members in solving sanitary problems and to maintain the individual resorts in a proper sanitary condition. Each resort, or group of resorts, should have some officer to perform this type of work. Though the department stands ready at any time to advise and assist resorts in solving their sanitary engineering and health problems, this does not relieve the individual resort of its responsibility.

Irrigation Statistics for 1920 Ready

Statistics of irrigation collected at the census of 1920 for the seventeen arid and semi-arid states are contained in a bulletin just issued by the Department of the Commerce, Bureau of the Census. The number of forms irrigated in 1920 was 231,541, a 42.3 per cent increase over the figure for 1910. The area irrigated was 19,191,716 acres, being an increase of 33 per cent in the ten-year interval. There were 26,020,477 acres capable of irrigation, an increase of 5,735,074. The total area irrigated was 35,890,821 acres.

High Piers of Railway Viaduct Braced by Trusses of Main Span

SLOW progressive yielding of the abutments or shore piers of a railway viaduct across the Rhine at Eglisau, Switzerland, recently led to the adoption of an unusual expedient to hold the piers and prevent their possible future collapse. As described in the *Schweizerische Bauzeitung* of March 18, 1922, this consisted of using the steel truss span crossing the river as a means of bracing the piers by strutting them apart. At the fixed end of the truss span the steelwork was blocked against a thrust bearing built out from the backwall of the pier, and at the movable end a bell-crank lever system (Fig. 2) was installed, bearing against the backwall and against the bottom chord of the truss. Cast-iron weights at the outer end of the horizontal lever arm apply a compression of 110 tons to

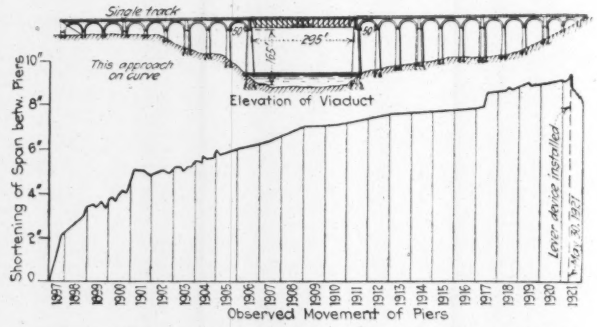


FIG. 1. RIVER SPAN SHORTENED NEARLY A FOOT DURING 23 YEARS

the bottom chord of each truss and thereby force the abutments apart by a total pressure of 220 tons.

The conditions that led to this course are to be gathered from Fig. 1, which shows a diagrammatic side elevation of the bridge and a plot of the shortening of the river span during the twenty-four years from 1897 to 1922. The bridge consists of limestone full-spandrel approach arches about 50 ft. in span, and a steel truss span across the river 295 ft. long. The main piers are about 165 ft. high from top of footing to bridge seat, or about 130 ft. high above water. Evidences of movement of the main piers were noted shortly after construction of the approach arches; the arches next the high piers settled slightly, and cracks developed in the arch barrel and spandrel walls. Subsequently these movements were kept under careful observation. From April, 1897, to June, 1921, the two main piers came together by 220 mm. (nearly 9 in.). At the expansion end the rockers were moved over so far that they had to be re-set in 1899, 1905, and 1920, and on the last occasion the bed plates also were shifted.

Sudden increase of the movement was observed in 1917. It was concluded that the masonry of the high piers had begun to crack on the tension side, and that further abrupt movements might be looked for. Means for remedying the condition were at once taken into consideration.

Replacement of arches by girder spans, which would have involved, of necessity, a considerable number of the approach spans, seemed impracticable because of high cost and because the work would have to be done under traffic. Study was therefore directed toward means of absorbing part or all of the unbalanced arch thrust at

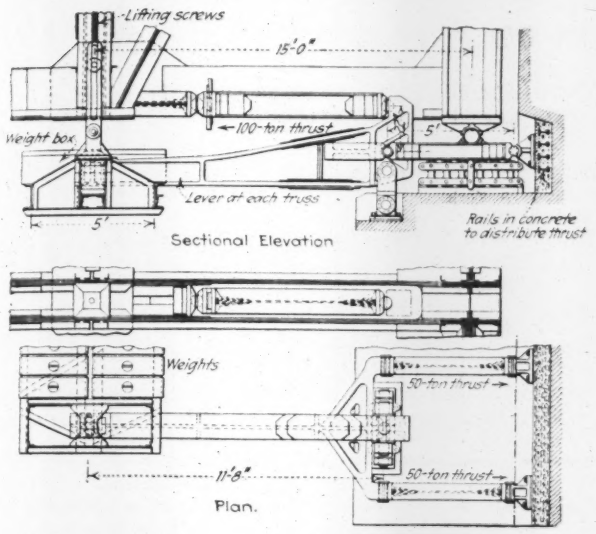


FIG. 2. WEIGHTED LEVER SYSTEM TRANSFERS 200-TON THRUST THROUGH TRUSSES

the main piers. The lever scheme shown in Fig. 2 was adopted. It was put in service by lowering the releasing screws at the first truss post on May 31, 1921. There is one lever at each of the two trusses, the weight box extending across the width of the bridge and being carried by both levers. Temperature expansion in the steelwork is taken care of by the pivoting of the levers. Expansion or other movements of the approaches have the same effect, the thrust of the steel span against the masonry being maintained unchanged. The effect of the device in seven months' service is reflected in the sharp drop of the pier movement curve, Fig. 1.

Some doubts were entertained as to the satisfactory working of the arrangement under trains. It was feared that resonant oscillation of the counterweights might develop, with possibly harmful effect on the masonry. Observations showed, however, that the longitudinal movement of the expansion end of the bridge under a heavy test train was negligibly small, perhaps partly due to the fact that the bridge has a ballasted solid floor. However, tests to verify the smoothness of action of the device were made after it was installed. Strain-gage measurements and other observations on the piers and arches were made at the same time.

Strain gages on the inner and outer surface of the barrel of the arch adjoining the right-hand main pier showed the following effect when the thrust levers were put in operation: At first there were large and apparently irregular movements which were attributed to the closing up of cracks in the masonry. When the weights were then lifted clear, and again lowered into action, the gages showed that in the extrados a tension of 35 lb. per square inch and on the intrados a compression of about half this amount were developed. Levels placed on the pier showed that at the bridge seat the pier was tilted backward, while at floor level the pier tilted slightly forward, as might be expected from the resistance of the masonry above the thrust line of the levers. Strain-gage measurements in the steel span showed only about 33 tons compression (reduction in tension) near the fixed end, of the 110 tons applied at the opposite end; the unaccounted for compression is believed to have been transferred to the top chord and thence into the rails.

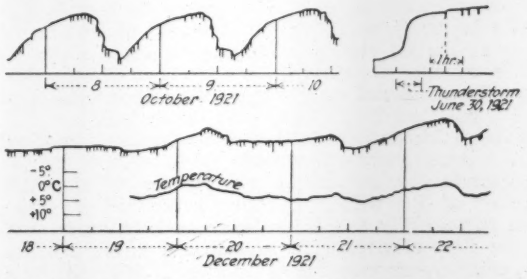


FIG. 3. LEVER MOVEMENTS DEPEND ON TEMPERATURE

Drawing shows part of record from a curve-drawing deflectometer placed so as to show the rise or fall of the lever weight. The movements are shown to one-tenth size, and are drawn inversely, i. e., pen moving up for lever moving down, or steelwork shortening.

The computed dead-load thrust of the approach arches is about 195 tons, the lever thrust exceeding this by 25 tons. Nevertheless, the curve in Fig. 3 indicates that summer expansion of the approach masonry was sufficient to overcome the applied thrust. In general a progressive backward motion resulted, however. By the end of 1921 it produced a rise of ¼ in. at the crown of the arches adjoining the main piers.

Recording gages were installed to register the vertical rise and fall of the weighted end of the lever due to the action of trains and temperature changes. Three such diagrams are reproduced in Fig. 3; in these the lever movement is given to one-tenth scale, and downward movements of the lever are plotted upward. The small lines projecting downward from the curve are due to the passage of trains. At the right the abrupt influence of temperature change in a thunderstorm accompanied by hail is made evident. The lower curve gives a direct comparison of the bridge movement and the change of air temperature, showing remarkably close correspondence.

The work was planned and carried out by the Swiss Federal Rys., under the direction of A. Bühler, bridge engineer. The C. Zschokke Co. of Döttingen, built the lever system. The total cost of the work was about 100,000 fr.

Railway Terminal Train Water Supplies

As a result of a study of methods employed in supplying drinking water and ice to an average total of 1,642 cars daily at 13 coach yards in Chicago, supplemented by similar observations in other cities, Arthur E. Gorman, assisstant sanitary engineer, United States Public Health Service, concludes: "The value of standardization became more and more convincing as the many and widely different variations in the simple procedures were noted. In discussing this matter with yard and coach foreman, these men were invariably of the opinion that standardization would be of value. It is believed that railroad and health officials could discuss standardization of coach yard design and practice with mutual value." Descriptions of the various methods of filling and cleaning water coolers, including the risk of pollution by the dragging of the rubber hose used for filling purposes through dirty yards, and methods of sterilizing coolers, are set forth at some length in *Public Health Reports* for June 16, 1922. Some of the various methods employed and chances for improvement in this work are illustrated by half tone views.

Survey of Electric Traction on American Railroads

Systems Now in Service Described and Compared for the Railroad Engineer — Trend of Locomotive Design—Tabular Review of Present Status

By George Gibbs
Consulting Engineer, New York

So much of what has been written on railroad electrification has regarded the subject from the electrical viewpoint that many railroad engineers and operating men have found it difficult to keep abreast of developments as affecting their broader and more general interests. This abstract of a remarkable report on the subject prepared by George Gibbs for the Ninth Congress of the International Railway Association, in which he surveys the present status of heavy electric traction from the railroad man's viewpoint, is addressed to those who want to keep in touch with this development but who have not been able to follow the more voluminous literature of the subject.—EDITOR.

IN 1910 electric traction was in service in the United States and Canada on eleven different railroads covering 411 miles of route, 873 miles of track, and employing 136 electric locomotives and 613 motor cars. At the end of 1920 these figures were: nineteen railroads covering 1,526 miles of route and 3,370 miles of track, employing 371 electric locomotives and 1,508 motor cars. Of these nineteen roads, five are equipped for city terminal operation of passenger trains, five for long tunnel operation both passenger and freight, three for suburban passenger operation, two for heavy-grade freight operation, and four for main-line operation of both passenger and freight.

The trend of American development has been primarily to secure better operating conditions, as, for example, (1) for terminals in large cities with tunnel approaches and elsewhere where steam locomotives are objectionable; also to reduce shunting and idle car movements by the use of motor-car trains instead of locomotives; (2) on heavy grades, to increase the capacity of the line and effect substantial operating savings; (3) for short-haul suburban passenger service to make more comfortable traveling and quicker schedules, and (4) for long-haul services to secure operating economy where coal is expensive and cheap hydro-electric power can be obtained. In such cases the direct operating savings plus the indirect advantages are sufficient to justify the adoption of electric haulage.

General Features—All electric traction systems comprise the same main features: (1) Power generation and transmission; (2) means to make the power available at the moving train; (3) motive power apparatus on the train. Three systems are in use: (1) Low tension, direct current, third rail; (2) high tension, direct current, overhead wire; (3) high tension, alternating current, overhead wire. Electric power may be generated at any desired voltage for any one of the three systems. For direct current systems, however, the power may be generated in the form of three-phase current at any of the established frequencies, while the alternating current systems require a low frequency. The primary current is carried from the generating station to local substations where it is transformed or converted to the kind and voltage required in the train motor.

Working Conductors — The working conductor, which is used to make the power available in the moving train, is perhaps the most important feature of the installation and is the one of most serious concern to the operating staff. It is everywhere present and must be installed and readily maintained under all physical and traffic conditions. It must be reliable and durable. A local failure of this element means failure of the system as a whole. Two kinds of working conductors are in use, third rail and overhead.

Third Rail—The third rail has the following advantages: (a) it permits the conduction and collection of very large volume currents; (b) it is located conveniently for inspection, repair, and replacement. The disadvantages are: (a) it does not provide continuous contact through complicated tracks, switches and crossings; (b) it obstructs the track structure and interferes with maintenance of permanent way and track, and obstructs the spaces between tracks, thereby menacing the safety of employees in shunting work; (c) it cannot be entirely inclosed and involves risk of contact by employees and others, (d) power is subject to interruption when snow or sleet collects on the conductors; (e) the economy and flexibility of low-tension current, which is necessary with this conductor, is inferior to that of high tension distribution. Because of these objections, third-rail traction may be considered obsolete for heavy railroad electrification.

The standard voltage for third rail has been 600, although 1,200 has been used in two cases of interurban railroads for cross-country lines. The writer does not believe that voltage even as high as 1,500 is sufficient for economical results and believes it impracticable to install a conductor for such a voltage that can be adequately safeguarded.

Overhead Working Conductor—This promises to become standard. The important features desired in designing this structure are sparkless collection, strength, durability, and cheapness. It is also important to avoid hard spots in the collector wire at the suspension points, which may cause sparking. As the collector wire is essentially a device for small current, the higher the working voltage the more successful becomes the overhead contact system.

The advantages of such conductors for heavy traction are: (a) it provides continuous contact at the train in places of complicated track layout; (b) it does not interfere with the maintenance of permanent way and track and may be employed safely at high voltages; (c) it insures uninterrupted service during sleet storms to a greater extent than does a third rail. Its disadvantages are: (a) the difficulty of collecting large currents; (b) the difficulty and delay in making repairs to the contact system where traffic is heavy, and (c) the difficulty of installation in cases of limited clearance at bridges, tunnels, etc.

The advantages, however, appear controlling, especially when the amount of current to be collected has been brought within practical limits by raising the voltage.

Voltage Limitation—In the single-phase, alternating current system, maximum voltage is determined by the requirements for economical maintenance of electrical insulation of live wires. In Europe, 16,000 volts has been used successfully and is probably as high as is desirable in the close clearances in tunnels and under bridges. In this country, for very heavy traction, 11,000 volts has been generally used and has been found suitable for the sparkless collection of current.

In the case of the three-phase system, voltage is limited by necessity of maintaining insulation between two con-

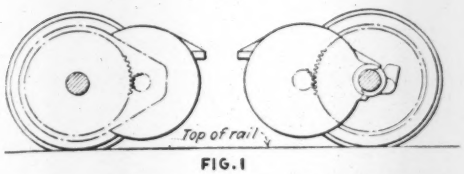


FIG. 1

FIG. 1. TYPE 1. DIRECT AXLE-GEARED DRIVE

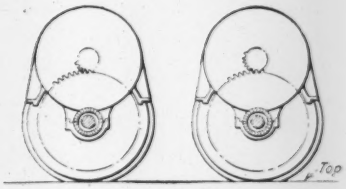


FIG. 2

FIG. 2. TYPE 1. SINGLE MOTOR GEAR AND QUILL DRIVE

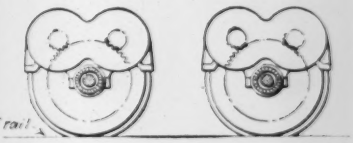


FIG. 3

FIG. 3. TYPE 1. TWIN MOTOR GEAR AND QUILL DRIVE

ductors of opposite polarity placed in close proximity. European experience places the practical limit at about 3,000 volts. The use of the three-phase system has not been seriously proposed for American railroads, chiefly because of the complications and expense of installing and maintaining two overhead contact wires with high voltage.

In the direct-current system having an overhead conductor the voltage is limited to the maximum suitable for generating apparatus and in the control and motors on the train. At present 3,000 volts appears to be the maximum allowable. This is too low to insure reliable collection of the large currents required for heavy service especially at high speeds. It has been sought to remedy this by using two contact wires side by side, but this increases the complication at switches, curves, etc.

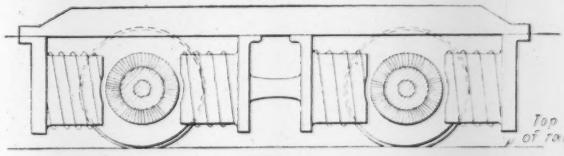


FIG. 4

FIG. 4. TYPE 2. DIRECT AXLE-MOUNTED ARMATURE DRIVE

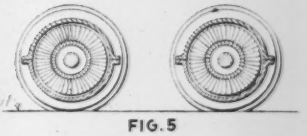


FIG. 5

FIG. 5. TYPE 2. GEARLESS MOTOR QUILL DRIVE

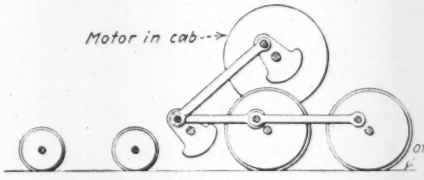


FIG. 6

FIG. 6. TYPE 3. ROD DRIVE WITH GEARLESS MOTOR
Pennsylvania Terminal in New York

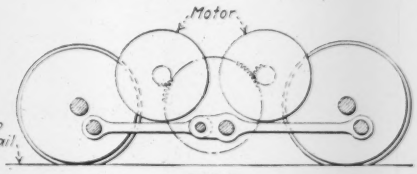


FIG. 7

FIG. 7. TYPE 3. ROD DRIVE WITH GEARED MOTOR
Norfolk & Western Freight Locomotives

Substations — Alternating-current systems require transformers only in substations to alter the voltage of the current, together with necessary switching and safety apparatus. Direct-current systems require transformers, switching apparatus for high-tension current, and rotary converting apparatus to change it into direct current together with the low-tension switching and safety appliances. The combination is costly and complicated and requires the presence of attendants.

Motive Power—For freight service and for through passenger trains electric locomotives are required, while for local passenger service motor cars are preferable. The self-propelled passenger vehicle for this service is one of the great advantages of electric traction over steam.

Locomotives—No approximation even to a standard electric locomotive design has been reached. The problems still ahead for solution are both electrical and mechanical. The former await the selection of a system, and the latter concern methods of transmitting power from the motors to the driving wheels and the best type of locomotive structure. The most serious present problems, however, are mechanical. In the opinion of many, axle weights of steam locomotives have been carried beyond advisable limits and in adopting electric traction thought should be given to a return to moderate wheel-weights for locomotives without disturbing present operating methods. This can be done by stringing together locomotive units to make one compound structure, singly controlled. This has not yet been carried into effect chiefly because of the high first-cost of such a locomotive. At present it is sought to reproduce mechanically the high concentrated wheel-weights of the steam locomotives, because of compactness and low first cost. This means using weights as high as 70,000 lb. per axle, which has accentuated the difficulties of applying and coupling the motors to the wheels in a proper manner.

Types of Drive—There are three general types of drive in service: (1) motors geared directly to the axles, (2) gearless motors mounted on or around axles, and (3) geared or gearless drive by means of cranks and rods.

Out of 390 locomotives in use on American railroads, 223 have some form of direct-geared drive with or without flexible connections. Fig. 1 shows the simplest direct gear, in which one-half or more of the motor weight is rigid on the axle. Fig. 2 shows a type in which the weight of the motor is carried on a quill which surrounds and is held free of the axle. Fig. 3 shows a similar design for a twin-motor gear. In both of these the axle is free of motor dead-weight and the center of gravity of the motors is raised with respect to the track.

Two principal forms of the gearless direct drive are in use. In the New York Central type (see Fig. 4) the motor armature is rigidly mounted on the axle and free to revolve

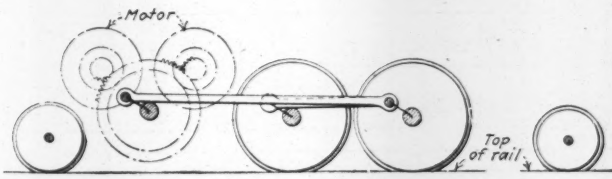


FIG. 8

FIG. 8. TYPE 3. ROD DRIVE WITH GEARED MOTOR
Proposed freight locomotives for Norfolk & Western R.R.

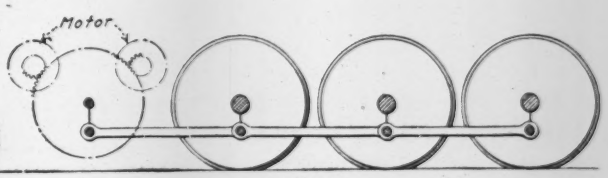


FIG. 9

FIG. 9. TYPE 3. ROD DRIVE WITH GEARED MOTOR
Freight locomotive for Pennsylvania R.R.

between bipolar fields carried on the locomotive truck frame. This has been used on high-speed passenger locomotives on the New York Central R. R. and on the Chicago, Milwaukee & St. Paul Ry. The driving wheels are of small diameter and the center of gravity of the motors and running gear is low. This type is not suitable for slow speeds because of the low output per pound weight of the motors. In the type used by the New York, New Haven & Hartford R. R. (see Fig. 5) the motor is mounted on a quill around the axle and carried by the spring-supported frame of the locomotive. The motor armature drives by means of a spider which carries pins inserted in spring pockets in the wheel centers. This permits the use of a large motor having its weight wholly spring-supported.

Several designs for geared or gearless rod-drives have been used in Europe, but the type has been adopted for only two important installations in America; the Pennsylvania R. R. terminal at New York and the Norfolk & Western heavy freight line over the Allegheny Mountains. The Pennsylvania terminal type is illustrated in Fig. 6, this being a gearless drive. The Norfolk & Western type now in use is shown in Fig. 7 and a proposed freight locomotive in Fig. 8. Each of these is geared from two motors. Fig. 9 shows a gear and side-rod drive built by the Pennsylvania R.R. for a projected mountain-grade electrification. The geared motor rod-drive permits of great tractive capacity with a high center of gravity both for the heavy masses and for the locomotives as a whole.

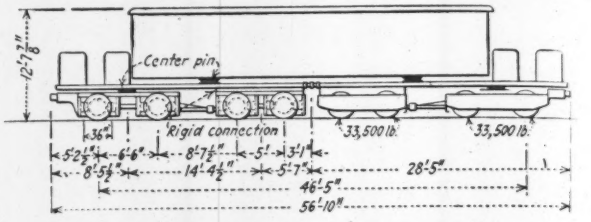


FIG. 10. NEW YORK CENTRAL PASSENGER
Wheels, 0-4-4+4-4-0—Eight Motors—Type 2 Drive; Fig. 1—10 in use—In service 1917.

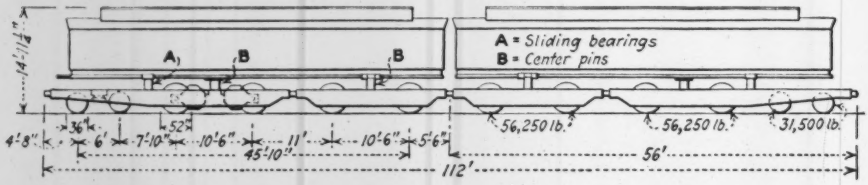


FIG. 11. CHICAGO, MILWAUKEE & ST. PAUL FREIGHT
Wheels, 4-4-4+4-4-4—Eight Motors—Type 1 Drive; Fig. 1—42 in use—In service 1916-1917.

Recent American Types — The earliest electric locomotives were for light service and were modeled upon the design of a motor-car; that is, with two bogies having axle-mounted motors and carrying a frame and body to house the control apparatus and the motorman. It was found necessary to modify this arrangement of parts to provide increased tractive effort and stability, especially at high speed, and numerous designs for the mechanical portion of the locomotive have resulted. Figs. 10 to 16 show outline sketches of some of the more recent American designs.

Trend of Locomotive Design—Engineers are not in entire agreement as to the development of these several mechanical arrangements for electric locomotives. Some of the divergence results from difference in viewpoint. The electrical engineer may lay stress upon features of the electrical design and prefer a type of locomotive which follows tramway practice. The railroad engineer, however, generally considers the problems he must meet to produce very powerful steam locomotives, especially those which have to do with proper tracking qualities, ease of access to parts for inspection and repair, etc.

It is difficult to indicate precisely the probable future trend of American practice. Evolution of types is proceeding in a normal manner as has been the case with steam locomotives, but general conclusions may be drawn. Some of these are as follows: Type 1 drive (motors geared directly to axles) is suitable only for slow-speed locomotives on shunting or freight service. For the heaviest freight requirements, however, it is doubtful if this type will be best, as it is difficult to produce a stable wheel grouping and as the heavy motor masses have low center of gravity with considerable weight not spring-borne. Large motors, furthermore, produce heavy side shocks in curving and with track in poor surface, and hub-liner wear is likely to be great.

Type 1 with quill-driven geared motors should produce better results, but only in degree. The quill drive is not entirely satisfactory for very heavy service as it is difficult to find space for conservatively designed springs and unless the quill is maintained normally concentric with the axle, severe bending stresses in addition to the normal torsion are set up in the springs at each revolution.

Type 2, which has the motor armature mounted rigidly on the axle, requires many axles for heavy traction and a wheel arrangement that is somewhat complicated and unfavorable for tracking. It has been used for high-speed work, however, where track construction is of the heaviest character and its maintenance of the highest order. Because of the low output of the motors at low speed its field is limited to high-speed service.

Type 2 drive, having gearless motors flexibly suspended around the axles, may be used for high-speed passenger locomotives with either d.c. or a.c. traction, but it is not an economical type as regards first cost of motors. It has a low center of gravity of the running gear and is subject to the difficulty already mentioned in securing durable, spring-driving mechanism.

Type 3, having gearless motors and rod drive, is suitable for high-speed passenger work with both d.c. and a.c. motors and allows the most desirable wheel arrangement and weight distribution for perfect tracking qualities of the locomotives. The motors, however, are large and costly because of their low speeds, and their capacity is limited. The type is not suitable for low-speed service.

Type 3, having geared motors and rod drive, offers the most flexible and promising solution of passenger and freight locomotive construction because of the allowable variation in wheel arrangement and in motor mounting and

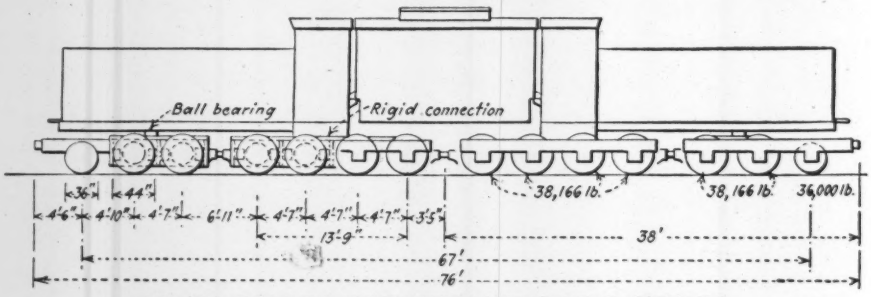


FIG. 12. CHICAGO, MILWAUKEE & ST. PAUL PASSENGER
Wheels, 2-4-8+8-4-2—Twelve Motors—Type 2 Drive; Fig. 4—5 in use—In service 1920.

capacity. It permits most perfect tracking qualities for a great variety of designs and running speeds, and is suitable both for d.c. and a.c. systems.

Side rods, connecting the various driving wheels, are desirable in all types to prevent slipping of independent axles and thus to obtain maximum traction, especially with d.c. motors having series multiple control. A combination of driving and carrying axles is desirable, also an unsymmetrical wheel distribution to assist in proper tracking.

Motor Cars—Because of the high schedule speeds and the many stops, suburban or "commuter" service is exacting and necessitates very high power requirements per car as compared with long distance runs. In addition to the power question, the suburban service demands maximum flexibility of operation in and out of terminals, so general practice tends toward making each car of suburban trains a motor car. Best economy in equipment and maintenance cost is obtained by using two motors mounted on one truck. A modern steel car about 70 ft. in length overall will satisfy these conditions and will weigh, without electric equipment but including full seated passenger load, about 100,000 lb.

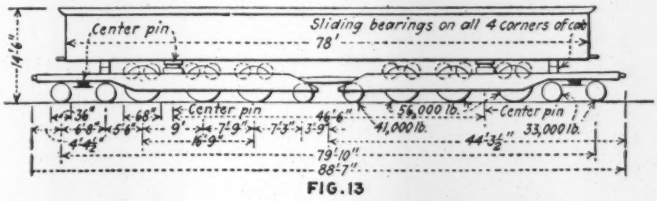


FIG. 13. CHICAGO, MILWAUKEE & ST. PAUL PASSENGER
Wheels, 4-6-2 + 2-6-4, Six Motors, Type 1 Drive; Fig. 3—10 in use; In service 1920.

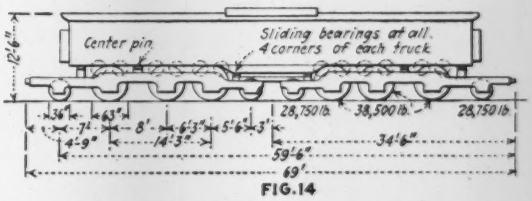


FIG. 14. NEW YORK, NEW HAVEN AND HARTFORD PASSENGER
Wheels, 2-6-2 + 2-6-2, Twelve Motors, Type 1 Drive; Fig. 3—5 in use; In service 1919.

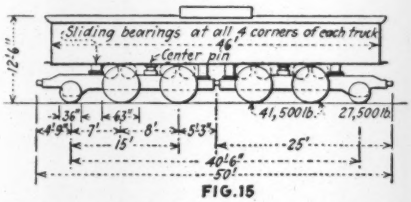


FIG. 15. NEW YORK, NEW HAVEN AND HARTFORD FREIGHT AND PASSENGER
Wheels, 2-4 + 4-2—Eight Motors—Type 1 Drive; Fig. 3—3 in use—In service 1912.

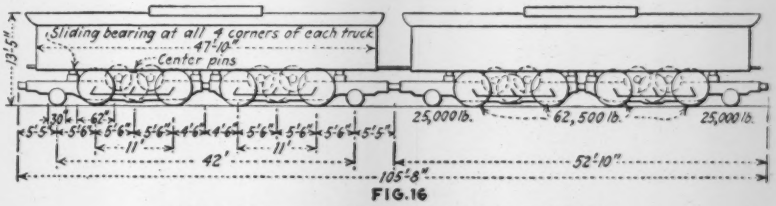


FIG. 16. NORFOLK AND WESTERN FREIGHT
Wheels, 2-4-4-2 + 2-4-4-2—Eight Motors—Type 3 Drive; Fig. 7—12 in use—In service 1915.

Two motors will give a capacity of about 500 hp. for the car.

In analyzing the relative advantages and disadvantages of various systems of electric traction it is desirable to keep in mind the importance of providing for suburban service of this character in the most economical and flexible manner.

Choice of Systems—During the past ten years the number of roads employing high tension current traction has considerably increased, while the third-rail system has not extended materially except to increase the mileage of existing installations. The high-tension installations all use the overhead contact, and on the basis of the number of installations the alternating-current system is most generally used. The field is narrowing to the use of two systems which appear in the present state of the art best adapted for heavy and for long distance railroad operation; the 3,000-volt, direct-current, and the 11,000-volt, single-phase alternating current.

Recently there has been a tendency to standardize practice. This is desirable if it does not stop evolution and result in a premature fixing of practice before technical and practical knowledge is sufficiently advanced. The writer believes it is somewhat early to fix upon standardization to an important degree for any system, much less to exclude any promising system. Development is proceeding along normal and logical lines and there is no reason to force a conclusion at this time by hasty action in any direction.

There is some reason to feel, however, that orderly consideration of the subject will not continue because of the views that are being generally expressed by those who are not engaged in operating the railroads but are connected with other industries. One of the two great electrical manufacturing companies in America is committed at present to advocacy of the direct-current system and does not offer train equipment for the alternating-current system; the other company has been responsible for the development of the alternating-current system and advocates its use but will furnish direct-current apparatus if the customer prefers.

The telegraph and telephone companies are unfriendly to alternating-current traction because of their fear of inductive effects on their lines from the traction currents. The commercial central power-station companies appear to consider it to their interest to advocate the use of direct-current traction as being the easiest system for them to supply. This is because they find it advantageous for their commercial lighting and power loads to use 60-cycle current, which is suitable for direct-current traction but cannot be used for alternating-current traction in the present state of the art without changing the frequency, which means added expense.

While these interests have views and are expressing them, the railroads have not taken a definite position as they are trying out what they have and awaiting further

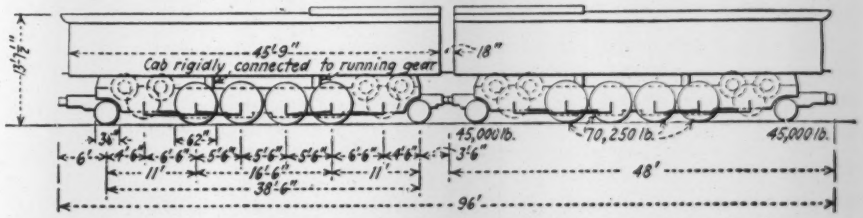


FIG. 17. NORFOLK AND WESTERN PROPOSED FREIGHT
Wheels, 2-8-2 + 2-8-2—Eight Motors—Type 3 Drive; Fig. 8—Proposed 1919.

HEAVY ELECTRIC TRACTION INSTALLATIONS, 1910 AND 1921

Railroad	Service F= Freight P= Passenger	System: Kind of Current	System: Type of Contact	Voltage: Trans.	Voltage: Contact	1910: Mileage: Route	1910: Mileage: Track	1910: Rolling Stock: Locos.	1910: Rolling Stock: Motor cars and Trailers	1921: Mileage: Route	1921: Mileage: Track	1921: Rolling Stock: Locos.	1921: Rolling Stock: Motor cars and Trailers
Baltimore & Ohio	F & P	L.T.D.C.	3rd R.		650	3.70	8.40	8	0	3.75	8.00	8	0
Long Island	P	L.T.D.C.	3rd R.	11,000	650	43.90	110.00		218	90.30	227.20	1	634
West Jersey & Seashore—P. R. R.	P	L.T.D.C.	3rd R.	33,000	650	74.60	162.70		89	75.00	160.38		107
New York Central & Hudson River	P	L.T.D.C.	3rd R.	11,000	600	22.50	101.00	47	180	57.90	268.30	73	241
Spokane & Inland	F & P	L.T.D.C.	O.H.	45,000	600					54.53	84.77	3	20
		H.T.A.C.	O.H.	45,000	6,600	135.00	135.00	9	36	129.18	145.42	7	19
New York, New Haven & Hartford	F & P	H.T.A.C.	O.H.	22,000	11,000	21.50	100.00	41		87.90	530.60	108	79
Erie	P	H.T.A.C.	O.H.	60,000	11,000	38.00	38.00		6	34.00	40.00		12
Grand Trunk	F & P	H.T.A.C.	O.H.		3,300	3.80	12.00	5		4.00	12.00	6	
Great Northern	F & P	H.T.A.C.	O.H.	33,000	6,600	4.00	6.00	4		4.00	7.00	4	
Southern Pacific	P	H.T.D.C.	O.H.	13,200	1,500 1,200	51.60	124.60		84	197.92	316.32		220
Pennsylvania; New York Terminal	P	L.T.D.C.	3rd R.	11,000	650	12.00	75.00	24		13.41	110.08	34	8
Michigan Central	F & P	L.T.D.C.	3rd R.		650					4.60	26.40	10	
Boston & Maine	F & P	H.T.A.C.	O.H.	11,000	11,000					7.92	20.91	7	
N. Y. Westchester & Boston	P	H.T.A.C.	O.H.	22,000	11,000					21.75	73.41	1	45
Butte, Anaconda & Pacific	F & P	H.T.D.C.	O.H.	100,000	2,400					25.30	122.30	28	
Norfolk & Western	F	H.T.A.C.	O.H.	44,000	11,000					29.13	108.26	12	
Pennsylvania; Padi & Chestnut Hill	P	H.T.A.C.	O.H.	44,000	11,000					30.00	224.77	1	115
Chicago, Milwaukee & St. Paul	F & P	H.T.D.C.	O.H.	100,000	3,000					646.70	860.40	62	
Total; U. S.						410.60	872.70	138	613	1,517.29	3,346.52	365	1,500
Canadian National	P	H.T.D.C.	O.H.	11,000	2,400					9.00	23.00	6	8
Total; U. S. and Canada						410.60	872.70	138	613	1,526.29	3,369.52	371	1,508

Summary	System: H.T.A.C.	System: H.T.D.C.	System: L.T.D.C.	Totals
1910: Number of roads	5	1	5	11
Route miles	202.30	51.60	156.70	410.60
Track miles	291.00	124.60	457.10	872.70
1921: Number of roads	9	4	7	20
Route miles	347.88	978.92	299.49	1,578.29
Track miles	1,162.37	1,322.02	885.83	3,369.52

Note
H.T. = High Tension
L.T. = Low Tension.
A.C. = Alternating Current.
D.C. = Direct Current.
O.H. = Overhead Conductor.
3rd R. = Third Rail.

information. Electrical engineers competent to pass upon operating as well as the technical aspect are neither numerous nor influential as compared with the powerful interests that are taking a stand on the subject. These engineers, moreover, are divided in their views.

The writer would not advocate one system to the exclusion of another and favors further trial of both alternating

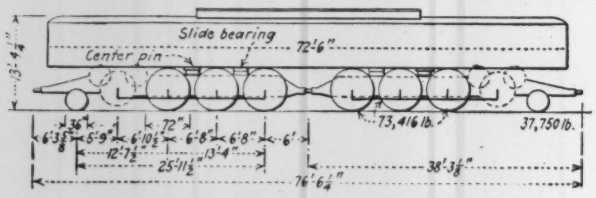


FIG. 18. PENNSYLVANIA RAILROAD FREIGHT Wheels, 2-6+6-2—Four Motors—Type 3 Drive; Fig. 9—1 in use—In service 1917.

and high-tension direct-current systems. He considers, however, that the high-tension alternating current has at present the greater number of demonstrated advantages for general railway use and holds out the most promise for the future. If, therefore, it were necessary to standardize now, it would seem to him illogical to select the high-voltage direct-current system, which has not yet been applied to all railroad operating conditions and which appears difficult of application to some, and to discard a system which has been so applied and is operating economically and well in all cases.

Tar-Treated Concrete Resists Salt Action

Investigations carried on by the Bureau of Public Roads on the waterproofing properties of water gas tar have indicated the possibility of utilizing this material as a means for protecting concrete from the action of saline solutions. It has been found that crude water gas tar having a specific viscosity of from 6 to 12 will enter freely, under atmospheric pressure, into dense concrete and mortar and is largely absorbed by the hydrated cement. Cement drain tile so treated have shown no signs of disintegration under test.

Respirator Will Protect Engine Crews Against Fumes in Tunnels

THE development of a pocket canister or respirator which will largely alleviate the discomfort to which engine crews are subjected by sulphurous locomotive smoke when passing through tunnels is announced by the United States Bureau of Mines. The canisters, which fit conveniently into a coat pocket, are filled with an absorbent mixture of activated charcoal and soda-lime, and contain filters of Turkish toweling. These small smoke respirators have had the hearty approval of the men who have used them, and retain their effectiveness for months. They may be cheaply made and are a great improvement over the sponge respirators and handkerchiefs and towels now used by engineers and firemen when passing through unventilated tunnels.

In a tunnel the crown deflects the smoke from the stack upon and around the locomotive. Mixed with air and exhaust steam, the smoke enters the cab, surrounding the engineer and fireman with a hot, vitiated atmosphere. Discomfort produced by the sulphurous smoke is intensified by the heat and humidity.

The experiments of the Bureau of Mines were conducted in 23 tunnels of the Baltimore & Ohio R.R. between Grafton and Parkersburg, West Va., in the Gallitzin tunnels of the Pennsylvania R.R. near Altoona, Pa., and in the Schenley tunnel in Pittsburgh. Various types of gas masks were worn by the experimenters in the cabs and by the engine crews in these tunnels; gas samples of smoke-contaminated atmospheres were taken in the locomotive cabs or at the cab windows and carefully analyzed in the gas laboratory of the Pittsburgh experiment station of the Bureau of Mines. Other tests were made by trackworkers and by the experimenters while in a tunnel on foot. Details of these experiments are given in Technical Paper 292, by A. C. Fieldner, S. H. Katz, and S. P. Kinney, which may be obtained on application to the Bureau of Mines, Washington, D. C.

Slag-Concrete Roads—Their Construction and Wear

Conclusions Based on Inspection of Over 100 Miles of Concrete Road Built With Slag Aggregate and in Service from One to Nine Years—Some Difficulties in Manipulation and Peculiarities of Wear

By C. S. Hill
Associate Editor, *Engineering News-Record*

Slag as concrete aggregate has been used for concrete roads for about nine years. In some places it is the most economical and easily obtained aggregate, but many engineers and contractors are not acquainted with its use or fear its wear. The present study is the result of an extended observation of slag-concrete roads under construction and in service. The conclusions are that while there are certain peculiarities of slag both as to manipulation and wear, concrete roads with it as the aggregate are in the main in as good shape as those using natural aggregate.

ABOUT 225 miles of slag concrete highways are in service in the United States. Practically all of this road has been constructed in six states, Ohio, Pennsylvania, Georgia, Indiana, New York and West Virginia, and a very large proportion of the mileage is county road. Ohio leads all other states with between 90 and 100 miles of slag concrete pavement dating from 1913 to 1921. All of these pavements are in service and considering their ages, the practice of the time and the maintenance they have received they exhibit no greater structural deterioration than is common to concrete roads of comparable age and construction in which stone or gravel aggregate was used. Surface imperfection in the form of pitting is almost invariable in slag concrete roads of any age which has permitted some amount of traffic wear and weather action to take place.

Slag is a compound of the impurities in the iron ore and of the limestone used as a flux in blast furnaces. It comes molten from the furnace and when it is intended for crushing it is poured in relatively thin layers on slag banks and allowed to cool. The cooled slag is excavated, crushed and screened for commerce. Crushed slag is a hard though very porous material, and makes an aggregate of considerably less weight than gravel or crushed stone. Offering a rough pitted surface for the adhesion of cement it produces a strong concrete. The larger producers take great care in selecting and curing the slag and in crushing and screening it for concrete aggregate.

Slag is an available aggregate in a number of states where steel manufacture is extensive. In sections of these states it can be laid down in stock piles for road construction at less cost than can stone or gravel aggregate. It is, therefore, in these localities a commercially logical aggregate for concrete roads. The only question of its utility is whether it gives as serviceable a pavement which can be constructed with no increased difficulty because of the nature of the aggregate. Tnere are varying opinions on both points.

It is probably not unfair to assert that generally the fitness of slag as an aggregate for concrete roads is regarded with a shade of doubt and in specific instances with actual distrust.

It is also generally assumed that pavement fabrication of slag concrete is more of a care than it is with gravel or stone concrete.

Specifications—Very few state highway departments provide specifically for slag as an aggregate for concrete roads and in these the specifications vary greatly in their quantitative provisions. Ohio has perhaps the most precise requirements. They are as follows:

The broken slag shall be clean, sound, durable, reasonably uniform in density and free from thin or elongated pieces. The chemical composition shall be not less than 32 per cent silica, not over 45 per cent calcium oxide and not over 1½ per cent sulphur. The slag shall show not over 10 per cent wear by the stone test or 20 per cent by the gravel test; have a toughness of not less than 5, and weigh not less than 70 lb. per cubic foot. It shall show no signs of checking, cracking or disintegration in the sodium sulphate test for soundness.

Colorado calls for a 78-lb. slag and Pennsylvania for a 75-lb. slag. These weights virtually eliminate all but a few slags which can be produced commercially. In general a 70-lb. slag, as specified in Ohio, can be produced from most slag banks without excessive picking and choosing. Most slag concrete roads and pavements of county and town construction have been built of slags weighing between 65 and 70 lb. per cubic foot.

Practice with respect to pavement sections and proportions does not differ essentially from that when stone or gravel concrete are used. The more recent sections are 5-7-5 in. and 6-8-6 in. in thickness and from 16 to 20 ft. wide. Older roads show various widths down to as narrow as 9 ft. and thicknesses of 5, 5½ and 6 in. Proportions vary in different states but run curiously uniform in all parts of the same state. In Ohio all but 8 of 44 sections are a 1:1½:3 mixture. In Pennsylvania a 1:2:3 mixture is nearly universal and in the south, Georgia and Alabama, it is nearly always 1:2:4. The size of slag runs from ⅜, ¼, ½ and ¾ to 1½ in.

While the proportions given are the nominal proportions, actually, in slag concrete paving, there is almost always some juggling of the proportions until the easiest working mixture is determined. As an example, the 18-mile slag concrete section of the Cleveland-Akron road built in 1921 was nominally a 1:1½:3 mixture and actually a 1:1¾:2¾ mixture. Generally speaking a moderately over-sanded mixture is easier to work.

Tests—Slag tests for the specific purpose of determining its qualities for concrete roads have been comparatively few. A series of investigations is now being conducted by the Bureau of Standards. Also some

study of the material has been made at Lewis Institute for the Portland Cement Association. In neither case have the records been announced for publication. Standard laboratory crushing tests indicate strengths quite as great as are required for pavements in ordinary construction practice. In fact no test results of slag concrete, which are known, give reason to doubt the satisfactory physical properties of this material for pavements.

Construction—Slag is light in weight compared with rock aggregate and it moves harshly, with perhaps more friction in chutes and a greater disposition to arch and "hang up" in bins. To these two qualities are due the chief concern in constructing slag concrete roads.

Because of its light weight the slag "floats" to the top of the slab and makes a somewhat harsher surface under the finishing roller and belt. The floating particles "drag" under the belt and float and do not permit the "soapy" finish that can be got under the belt or float with a stone and gravel concrete. These obstacles to easy finishing should not be exaggerated. They necessitate more care and somewhat different methods but not much more labor or expense. It is said by contractors experienced in slag concrete road construction that "one has to learn how to handle slag but afterwards it is no more troublesome than other aggregates."

The tendency of slag to arch and hang-up requires steeper slopes and larger passages in bins and chutes. It "shovels" with a little more difficulty than broken stone but its weight is less and larger shovels can be used. It is not appreciably more difficult to dig and lift with clamshells and generally larger buckets can be employed. Compared with stone or gravel it is a clean and dustless material to handle.

To finish slag concrete satisfactorily does not require different processes and tools but different ways of using the tools and performing the processes. On the whole perhaps belt finishing is least adaptable. In addition to "pulling down the crown," an objection general to the process, the belt catches the sharp slag particles and shuttles them back and forth scoring the surface. A better tool is the float, or a thin board used like a belt but capable of being lifted and laid down and so used to press down the floating particles until the mortar submerges them and slightly stiffens around them. Machine finishing is entirely practicable to strike off and tamp the slab but not for belting. In some recent large slag concrete road operations the belt, after a brief experience, has been taken off the machine and hand tools substituted for the fine finishing.

Service—Inspection of some 20 slag concrete roads built from 1913 to 1921 and aggregating approximately 100 miles has led to the following conclusions:

1. No disintegration of slag concrete roads certainly due to the slag content of the concrete were observed. In one instance a slag concrete base for a bituminous surface was found where many blow-ups were attributed to temperature action on concrete water-soaked because of the porosity of the "second class concrete base." Nowhere was evidence presented of any unsoundness of concrete because of any chemical content of the slag aggregate.

2. Slag concrete roads exhibit longitudinal and transverse cracking, corner breaks, shattering due to blow-ups and heaving subgrade and heavy traffic loads, and practically every other sort of failure characteristic of paved roads but to no greater degree than other concrete pavements of corresponding ages and construction practice.

3. Most of the slag concrete roads inspected appeared at a disadvantage because of poor maintenance. These were county maintained roads. Old cracks had not been filled and corner breaks and zones shattered by heaving or other cause had been allowed progressively to develop until the pavement presented a ruined appearance which it would not have presented had repairs been promptly made.

4. Practically all slag concrete roads exhibit surface imperfection due to general pitting. This pitting is caused by the breaking and crumbling out from the mortar matrix of the pumice or light friable slag particles which come to the surface during construction. It is a curious circumstance of this condition that the small pits ranging from ¼ to ½ in. in diameter and depth left by the disappearing soft slag, do not often enlarge by breaking down at the edges. They are a defacement rather than a structural damage, as they were observed in some scores of areas minutely examined at random.

Development—The critical task in developing slag concrete pavement is to eliminate pitting and to eradicate the impression that there is some danger to concrete soundness in the chemical constitution of slag.

Pitting, as stated, is due to light friable particles, or pumice, which are a content of every slag, rising or floating to the surface of the wet mixture and then breaking up after the pavement is in service and leaving a pit in the mortar matrix. The weight requirements of slag aggregate specifications, as they are quoted in a previous paragraph, are designed to reduce the percentage of pumice. No practicable weight requirement, however, can correct the difficulty entirely without putting slag out of consideration commercially as a road concrete aggregate.

To separate the pumice from crushed slag by some mechanical process which is economically practicable is the big technical problem in slag production. There is a margin of only a fraction of a dollar a ton within which slag can compete in price with crushed stone or gravel. Any process of pumice separation to be commercially practicable must operate well within this narrow margin. This limitation has so far put out of consideration any flotation or jigging process and of course screening does not meet the situation. The problem as yet has proved unsolvable.

Overcoming the mistrust of chemical troubles from the use of slag is a matter of proof and education. The proof lies in the structures built and remaining invariably sound and in the laboratory studies now in progress.

For Improved Cast-Iron Car Wheels

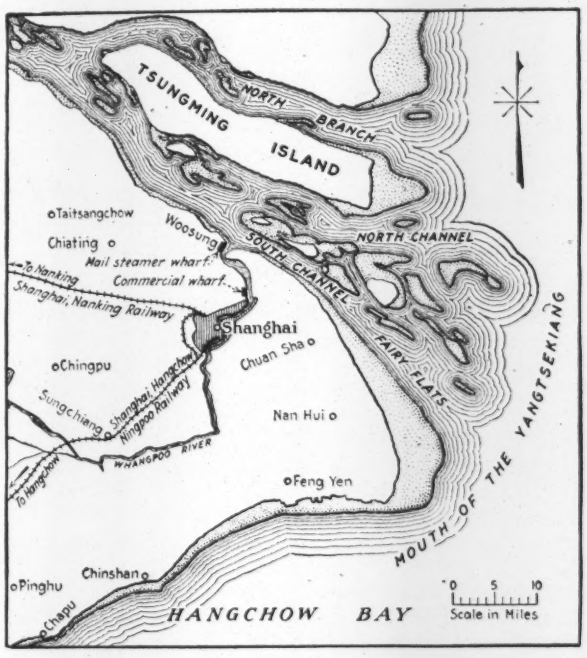
Thermal stresses in chilled cast-iron car wheels were investigated at the Bureau of Standards recently by G. K. Burgess and R. W. Woodward, with the result of suggesting possible improvement in wheels to make them more resistant to cracking under the heating developed by prolonged brake application. The investigation is reported in Technologic Paper No. 209.

Report Plans for Development of Shanghai Harbor

International Commission Recommends Creation of New Port Authority and Plans Whangpoo River Wharf Improvements

EXTENSIVE improvements to the approaches and the harbor proper at Shanghai have been recommended by a special committee of consulting engineers which has been studying the subject under the direction of the Whangpoo Conservancy Board.

The actual work of the commission was to consider and report on the further harbor development possibilities at Shanghai: (a) with the approaches to and limit of draft in the harbor remaining as at present, 28-30 ft.; (b) for the probable maximum draft of ships



SHANGHAI AND ITS HARBOR APPROACHES

on the Pacific. A consideration of these questions involved, among other elements, the possibility of improving the Yangtze estuary bar, the alternative question of a Hangchow Bay approach, and the provision of improved berthing accommodation and general port improvement, even with approaches remaining as at present.

The schemes submitted to the committee included a general consideration of all conceivable possibilities, but more especially various suggestions for dredging or training the great Yangtze bar, known at the Fairy Flats, design for a *port de vitesse* on the Hangchow Bay as an alternative to an improved Yangtze approach and layouts for first-class wharf accommodation in the Whangpoo and elsewhere.

The report includes among its recommendations the revision of the agreement as to the Whangpoo Conservancy between the Chinese government and the foreign powers, so as to provide a proper harbor authority, the dredging of the Yangtze bar, and the provision of a mail-steamer wharf near the mouth of the Whangpoo and a commercial wharf and docks below Shanghai. The immediate expenditure of 11,000,000 taels is recommended and the general lines are laid down for future development. The report has been forwarded to the Chinese government for its consideration.

Proposed Organization—The board proposed to administer the port authority is to consist of Chinese officials, representatives of shipping and trade in Shanghai, and a general manager to be appointed by the board who shall be, *ex officio*, vice-chairman. The chairman shall be selected from among the Chinese officials, who shall include local representatives of the customs and railways, appointed by the government to hold office so long as they fill the position by virtue of which they sit on the board.

Draft of Ships—The committee is of the opinion that the trade of the Pacific will in future be carried in vessels of greater draft than those now in use and that in a few years a draft of 33 ft. may be reached in the larger vessels. It proposes therefore a first improvement to enable ships of 33 ft. draft to enter at neap high tide with provision for progressive increases in depth as required.

Approaches—The committee recommends that improvement of the south channel be carried on by dredging only and that extensive and continuous observations be instituted to provide further information for future operations. It recommends for immediate action the dredging and maintenance of a channel through the Fairy Flats attaining as soon as feasible a bottom width of 600 ft. for ships drawing 33 ft. at ordinary neap high water.

Dr. Hiroi filed a reservation on this point to the effect that before being committed to dredging as a definite scheme of improvement, experimental work should be undertaken by means of trenches through the Fairy Flats with systematic observations of the time and manner in which the filling of the trenches takes place. The other members of the committee dissent from this and urge that there is no reasonable doubt as to providing and maintaining a greater depth by dredging. The one condition they wish to lay down is that the dredging operations should be on a really extensive scale.

The committee recommends the acquisition of at least two dredges of the most powerful type which can be operated on the Fairy Flats in a depth not exceeding 18 ft.

Harbor Improvement—The committee recommends that public quays and moorings be provided, that a commercial dock be installed on the west bank of the Whangpoo as near Shanghai as practicable, and that mail steamer accommodations be arranged also on the left bank near the mouth of the river, both works to be designed to admit of further extension when required. They recommend that existing foreshore areas and conservancy land be utilized so far as possible and that sufficient adjacent land be acquired for future development. They propose further that the Whangpoo regulation be continued to whatever depth may be required and practicable and that cross river communication be by ferries.

For immediate needs the committee recommends that 600 ft. of wharf be built on the left bank of the river near its mouth to serve mail and passenger steamers, and that 2,500 ft. of wharf with necessary transit sheds, warehouses, canal frontage and provision

for rail connections be installed just below the city.

Estimates of Cost.—The cost of the improvements is estimated as follows:

	Taels.
Improvement of approaches:	
Survey equipment: Seagoing survey ships, instruments, etc.	200,000
Dredging equipment: Two dredges, auxiliary plant, barges, tugs, buoys, etc.	4,200,000
Incidental equipment: Small towboats and other appurtenances	125,000
Harbor work:	
Equipment for Whangpoo River regulation (for training walls, reclaiming land, etc.)	725,000
Commercial wharf and dock: 2,500 linear feet of public wharf; 3 transit sheds (120 by 500 feet); warehouse, 3-story (120 by 500 feet); open storage, 360,000 square feet; lighter and native craft accommodation, 100 by 1,800 feet; appurtenant terminal works, such as railway, roadway, paving, mechanical equipment, lighting, etc.; total cost, including interest during 3 years' construction period	4,500,000
Mail steamer wharf: 600 lin. ft. of wharf; transit shed, 50 x 250 ft.; appurtenant rail, roadways, paving, lighting, etc.; cost, with accrued interest during construction period	620,000
Purchase of 19 moorings	380,000
Total capital cost	10,750,000

The par value of the Shanghai tael is about $0.67, but the present exchange value is about $0.77.

Personnel of Committee.—The committee consisted of Maj. Gen. W. M. Black, formerly chief of engineers, U. S. A., now of Black, McKenney & Stewart, Washington, D. C.; F. Palmer, of Rendal, Palmer & Tritton of London; P. G. Hornell, Hydraulic Engineering Bureau, Stockholm, Sweden; P. Ott de Vries, until recently head of Department of Public Works, Netherlands, India; L. Perrier, chief engineer of the Corps des Ponts et Chaussees, Paris; Dr. Isamu Hiroi, member of Harbor Investigation Committee, Tokyo, Japan, and Capt. H. von Heidenstam, engineer-in-chief, Whangpoo Conservancy Board, to whom we are indebted for the foregoing information.

Emergency Revetment on River Diversion Channel

Caving of Bank Stopped by Brush Mattress Built on Berm by Unskilled Labor and Hauled Over Slope by Cables

By E. S. Blaine

Resident Engineer, Little River Drainage District, Cape Girardeau, Mo.

TEMPORARY protection of an eroded slope in anticipation of coming floods was built in haste this spring on the headwater diversion channel of the Little River Drainage District, in Missouri. The engineering works of this extensive drainage district were described in *Engineering News* of Aug. 24, 1916, p. 342, and *Engineering Record*, June 24, 1916, p. 826.

During the March flood of 1920 this channel was eroded through to the sand stratum at a number of places. The November flood of 1921 washed sand from one of these spots, undercutting and carrying away the berm to a maximum width of 30 ft., so as to leave only a few feet of berm at the middle of the section affected. Some temporary protection had to be placed here before the regular March and May flood periods. The only equipment available was a small barge and this was used to transport willows as it was too small to use for weaving a mattress.

It was decided to build a mattress on the slope and pull it in as constructed, but by the time work was started the bank had caved so close to the levee in the central part of the reach that the slope could not be graded flat enough to permit men to work on it.

FIG. 1. WEAVING MATTRESS ON BERM

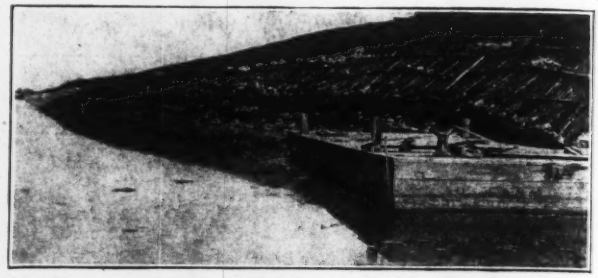


FIG. 2. MATTRESS IN PLACE AND WEIGHTED WITH STONE

For this reason the mattress was built on the remaining berm and levee slope, as shown in Fig. 1, and launched by two small man-power stump pullers on the opposite bank. The mattress was made up to suit the existing conditions. No labor was available with experience in weaving the basket mattress used on the Missouri River or the fascine type used on the Mississippi River.

Picks and shovels were used to grade the bank to as flat a slope as the remaining berm would permit. Deadmen were buried at 15-ft. intervals in the toe of the levee. Loops of ⅜-in. galvanized strand fastened to the deadmen were left projecting from the ground for use in anchoring the mattress. Transverse cables of ⅜-in. strand were cut long enough to go under the full width of the mattress and back over the top. These cables were laid in place opposite each deadman with half the length of the cable coiled up at the location of the lower edge of the mattress. Longitudinal cables of ⅜-in. strand were laid at 10-ft. spacing the full length of the mattress and cut long enough to lap back over the top of the mattress for its full length. The intersections of the cables were fastened temporarily by wiring.

A layer of willow brush about 5-in. thick was placed on this cable net so that each lap in the brush came over a longitudinal cable. The brush was laid at an angle of about 60-deg. to the longitudinal cables, which was as near 45-deg. as the length of the brush would permit on this cable spacing. A second layer of brush of the same thickness was laid with the angle the opposite way. The transverse and longitudinal cables were then brought over the top of the willows and the intersections of the bottom and top cables were clamped together with four-part clips.

Transverse cribbing poles were placed at 7½-ft. intervals and the mattress was tied together with No. 10 galvanized wire ties running under the bottom cables

and over the top cables. These ties were spaced at 30-in. intervals along both transverse and longitudinal cables. Longitudinal cribbing poles were then fastened to the mattress by ties of ⅜-in. strand at each cable intersection and at each intermediate transverse pole. The strand ties were twisted tight on top with heavy mattress hooks.

Hitches for launching the mattress were made at the four-part cable intersections. A two-ply length of ⅜-in. cable was fastened to the lower edge of the mattress at each cable intersection. A loop on the end of each of these launching cables was stapled to a cypress block which permitted successive hitches to be made when the edge of the mattress was under the water, as was the case until two launchings had been made, when, enough mattress was in the water to permit it to float.

After the mattress was placed in its final position, it was sunk in the usual manner by weighting with riprap unloaded from the barge. Fig. 2 shows the completed work.

This mattress patch was 375 ft. long and 50 ft. wide, containing 187 squares. About 265 cu.yd. of riprap were used to weight it. For 25 or 30 ft. at the upstream end the rock was placed nearly solid to prevent drift from catching and turning the mattress back. Almost double the actual amount of rock necessary to sink it was used because the hole was irregular and the bank entirely too steep for this type of protection, so that it was desired to have the mattress weighted down close to the surface.

The construction was done by district forces under the direction of T. G. Whitelaw, maintenance overseer. Its cost was $2,800 including the grading, or about $15 per square.

This protection has already gone through two fair-sized floods with no signs of further caving of the banks. It is intended only for temporary protection as plans are under way to provide protection of a more permanent nature.

The original design was prepared by the writer and approved by L. L. Hidinger, chief engineer.

Just Suppose

Just suppose all union labor should adopt a new way of paying their leaders, giving them an increase of salary when their men had obtained higher wages, a reduction when the wages of the men had been reduced and no salary at all when there is a strike, how many strikes would there be in ten centuries? Think of the amount of real hard work the leaders would do to get their men a raise. Think of the desperate efforts they would make to prevent a cut. But not by striking. Heaven forbid. Think of all the tricks the leaders would learn to accomplish their object, whereas now they know only one. Maybe they know more, but anyhow they *use* only one. Think how everyone would work up, and perfect and polish up his own union, so as to get a higher price for his wares. Think of all the union leaders' weeklies, monthlies and quarterlies to spread and promote scientific union management. But no, this will never happen, it is not practical. We should not expect the union leader to introduce such revolutionary methods, and if they don't, who will? The men? What have they to say about such matters? No, this will never come to pass, but—Just suppose.—*American Machinist.*

Ontario "Hydro" Replies to the Murray Charges

Denies That Government Utilities Are More Expensive Than Private—Says Charges Are Incorrect and Misleading

IN a 53-p. pamphlet the Hydro-Electric Power Commission of Ontario has replied to the so-called Murray report on electric utilities made by W. S. Murray, of Murray & Flood, consulting engineers, New York City, for the National Electric Light Association and published in March of this year (abstracted *Engineering News-Record*, March 16, 1922, p. 453). The Ontario pamphlet is entitled "Refutation of Unjust Statements Contained in a Report Published by the National Electric Light Association entitled 'Government Owned and Controlled Compared With Privately Owned and Regulated Electric Utilities in Canada and the United States Respecting the Hydro-Electric Power Commission of Ontario.'" The pamphlet is prefaced by an abstract of the conclusions of the commission written by Sir Adam Beck, chairman of the commission. There is no signature to the main report which follows. In effect, the commission's pamphlet is a denial of the main charges made by Mr. Murray and a violent fling at Mr. Murray's methods of argument. The substance of the reply may be given in the following paragraph from the pamphlet:

"In entering upon this discussion of the true character of the Murray report it is charged that, in addition to misrepresenting the achievements of the Hydro-Electric Power Commission of Ontario, Mr. Murray has made grossly incorrect and misleading statements; he has garbled documentary and other data, and then employed them as premises from which to draw conclusions; he has made pronouncements based upon comparisons so inadequate as to be puerile; he has made charges which he fails to substantiate; he has ignored important factors, even disregarding most pertinent engineering data; he has seriously miscalculated the cost of Niagara power; he has omitted to describe the confines of districts he discusses; he has not shown how summaries have been derived; he has made comparisons between unlike units; with respect to the cost of power he has shown himself painfully lacking in the application of engineering economics; and he has failed to supply data essential to the integrity of the claim of reporting in an 'exhaustive and impartial' manner. In a word, the charge of Mr. Murray has employed methods demonstrably reprehensible and unprofessional."

The separate points taken up in the pamphlet are too long to be more than abstracted here. They will be given, however, in such abstract.

It is charged that Mr. Murray purposely confuses government ownership with municipal ownership. It is contended that the Ontario system does not have the special obloquy attached in the United States to the term government ownership, which not infrequently carries as a concomitant political domination in the appointment of employees, in the purchase of supplies and equipment and in various other more or less hidden ramifications, which inevitably tends toward inefficiency and mismanagement. These destructive agencies, according to the pamphlet, are completely lacking in the functioning of the hydro-electric power system within

the province of Ontario. There is no political interference there.

It is charged that Mr. Murray misrepresents powers legally vested in the commission and misquotes the laws constituting the commission. This is important in respect to the Murray charge that no suit can be brought against "Hydro" except by fiat from the Attorney-General, "and to date no fiat has ever been granted." The pamphlet states that this is utterly without foundation and contrary to facts, that since 1912 more than twenty-five fiats have been granted to the Attorney-General to permit legal action to be brought against the commission. It is claimed, too, that the fair dealing of the commission cannot be successfully denied.

Street Lighting—The Murray report said that in Buffalo the per capita cost of street lighting is lower than it is in Toronto. According to the pamphlet, this statement disregards the fact that out of a total of 15,000 street lights in Buffalo over 8,800 were not electric, and that if this is taken account of the cost of street lighting in Toronto per capita is less than in Buffalo.

Mr. Murray is also charged with misrepresentation in his comparison between the average cost of power to the people of California and of Ontario. The criticism is made that he carefully builds up a comparison between the Niagara district of Ontario and the California hydro-electric districts so as to create in the reader's mind the idea that he is going to compare rates there and then switches over to a comparison between California and that part of Ontario "served by other than the Niagara system." These "other than the Niagara" systems are one-seventh of the total load of "Hydro," according to the pamphlet, so that they are the most expensive units in the province. The comparison made by Mr. Murray, therefore, it is claimed is not fair.

Mr. Murray contended that the principle of service at cost adopted in Ontario is not sound and according to the "Hydro" report believes that rates should be determined rather on the basis of expediency. In defense of the "Hydro" system it is stated that the municipalities of Ontario are not at all in accord with Mr. Murray's views in this respect, and are convinced that the supply of service at actual cost is the greatest safeguard which they could have against any unfair or discriminatory process in fixing rates. In determining rates at which service can be supplied to the various municipalities, the commission takes into account all factors entering into the cost of operation on definite principles, which results in each municipality paying its full and proper share, no more and no less. In answer to Mr. Murray's feeling that the application of rates based on the actual cost must result in concentration of industries in municipalities close to the source of power, the report says that the cost of power is only one of a large number of factors governing the decision of manufacturers as to their points of location. "Those familiar with the municipalities in the Province of Ontario which are partners in the co-operative municipal enterprise, know without further argument that Mr. Murray's contention is entirely fallacious, and that no such concentration of industries close to the source of power, as he fears, has resulted or is likely to result from the broad based and soundly constructed rate structure of this enterprise."

The Murray report charged that the cost of power supplied in Montreal and Buffalo by private companies is lower than the cost in Toronto as supplied by the Hydro-Electric Power Commission; to prove this point, Mr. Murray took the total revenue of the power companies in each city and divided this figure by the total number of kilowatt hours generated. This latter figure included all of the power supplied to a number of electro-chemical companies at exceedingly low rates, many of which companies have a directorate interlocking with that of the power company. The true comparison between the rates for service in the cities of Toronto, Montreal, Buffalo and Detroit, according to the "Hydro" defense, can only be made by comparing consumers' bills based on the published rates at which current is supplied in these cities. This comparison, set out in the report, is intended to demonstrate that the rates for service in Toronto are lower by an exceedingly wide margin than the rates in any of the other cities with which comparison is made.

In answer to the charge that "Hydro" pays no taxes, and that part of the necessary revenue for the operation of the system is collected through taxes of the municipalities, the report states that the commission and the hydro-electric systems in the various municipalities are subject to taxation on all lands which they occupy, and there has never been a single cent collected in the taxes of any municipality to be used in connection with the operation of any hydro-electric utility.

Nipigon and Chippawa—There is, finally, an elaborate defense of the technical features of the Nipigon development, which was classed as unnecessarily elaborate by Mr. Murray, and of the cost of the Queenston-Chippawa development, which Mr. Murray criticized as over expensive. In connection with the latter system Sir Adam Beck's summary reads as follows:

> In presenting his estimates of the cost of Niagara power with the Queenston-Chippawa development operating under various deliveries of power, Mr. Murray commences by making a number of gratuitous assumptions respecting the amounts of water which will be available, the extent to which he states existing installations will have to be scrapped, and so on, and then, he proceeds in a most astonishing manner to inflate estimates by millions of dollars. For example, in an important instance he has employed an interest rate of 8.15 per cent, thereby imposing a fictitious annual charge upon the commission's operations of over $1,600,000. In another instance he has provided over 2,000,000 annually for the renewal of plant equipment which he proposes to scrap, and which would not be renewed at all. By inflation and other devices, he has estimated a total annual production cost for power of $12,310,000 instead of what this total would be if correctly estimated under his own assumptions, namely $7,200,000. In this instance, he has overestimated the cost of power to the Niagara system by about $11 per horsepower or 75 per cent. Evidently Mr. Murray's views of engineering economics demand serious attention and revision.

Reversible Rails Approved in India

Double-head rails of the old reversible type, originally used on British main-line railways, are preferable to the more modern type of bull-head non-reversible type now generally used, according to a paper by R. Strachey, chief engineer of the East Indian Railway. Double-head rails as laid originally had the lower head resting on the cast-iron chairs and thus became indented so as to form a rough surface when inverted or reversed. With the cast-iron plate and pot ties used extensively in India, the rail is supported by its upper head resting on bearings, the lower head being free of any support.

Modified U-Type of Abutment As Used in Wyoming

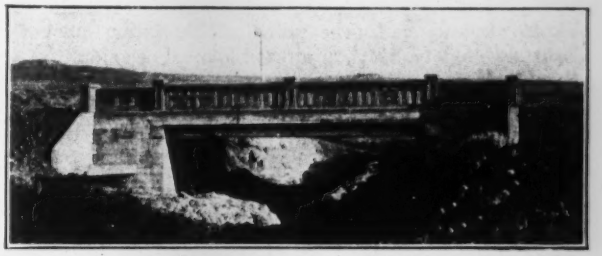
Economy Obtained Over Wing-Wall Type—Length of Structure Increased at No Extra Cost Enhancing Appearance

By J. F. Seiler
Engineer of Bridges, State Highway Department of Wyoming, Cheyenne

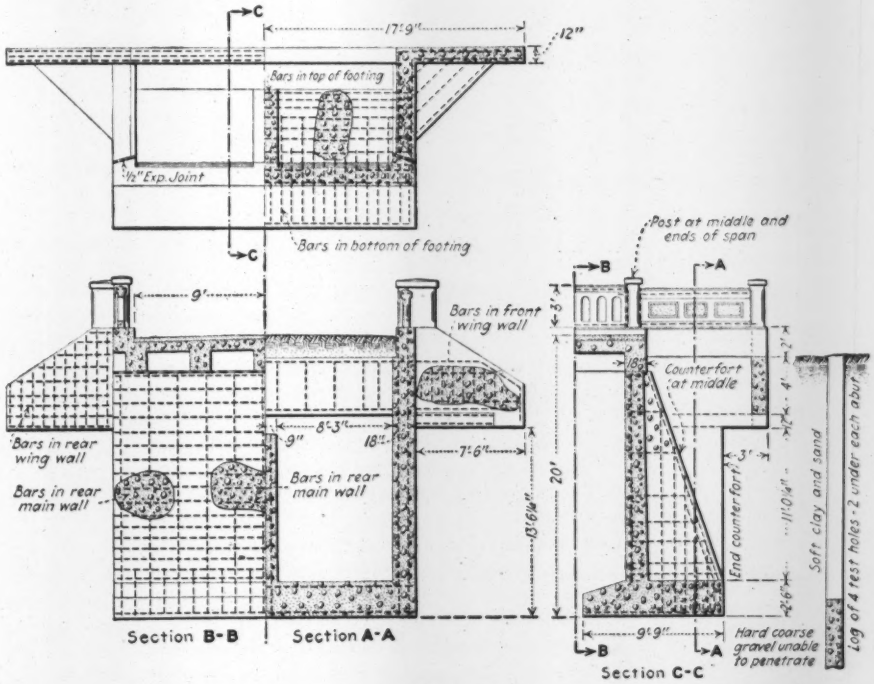
SINCE the beginning of its existence the State Highway Department of Wyoming has faced the vexatious problem of economically bridging the many narrow but deep streams or draws crossing her highways. The conditions usually existing are narrow waterways with steep banks on one or both sides, the soil being a loamy clay, usually with sand or gravel beds at some considerable depth below the surface. Not infrequently it is necessary to design 30 or 40-ft. spans resting on abutments 24-ft. high. Thus in the abutments of these structures a large sum of money is expended far out of proportion to the balance of the structure. The great cost of such bridges is not understood by the public.

The department recently has designed a modified U-type abutment which gives considerable economy over the old wing-wall type. In addition the new type yields other favorable results. In this design the side walls of the abutment, which also serve either as counterforts or buttresses depending on the position of the resultant pressure, may be carried back as far as necessary to take care of the slopes of the approach fill. A tie beam is furnished to take up the lateral pressures between these side walls, and is located at their rear in line with the wing walls, which extend out at right angles to the center line of the roadway. These wing walls may also be carried out as necessary to take care of the slopes of the roadway fill. Between the side walls and wing walls in the exterior quadrant are furnished one or more horizontal buttresses which transmit and to some extent equalize the pressures on the opposite faces of these walls.

The footings of large abutments may be greatly decreased by extending the side walls beyond the limits of the footing, thus producing, by means of their weight and that of the wing walls and tie-beam together with the frictional resistance of the earth resting against them, a very large righting movement. One or more counterforts located between the side walls reduce the stresses in the front wall set up by the horizontal beam action, while the side walls nearly approach the condition of a slab supported on three sides. The tie beam acts as a fixed beam supporting such loads as may come upon it.



BRIDGE WITH U-TYPE ABUTMENTS OVER BIG MUDDY CREEK NEAR CASPER, WYO.



CONCRETE ABUTMENT FOR 30-FT. SPAN BRIDGE OVER BIG MUDDY CREEK

In order to simplify calculations and at the same time design very conservatively, the highway department uses the equivalent fluid pressure method, using 27.5 lb. as the weight of the fluid for calculating the horizontal forces. Ordinarily this gives about 0.5 as the ratio between width of base and height of abutment. While this approximate ratio has thus far been adhered to even in this type of abutment, the department expects to make very considerable reductions in this ratio and take full advantage of every economy to be had in this type.

The department has recently constructed one of this type of abutment at a point on the Yellowstone Highway about 15 miles east of Casper. While no explanations are needed in connection with the view of this bridge, it is interesting to note at least one important feature which appeals to the engineer from a psychological standpoint, and that is the additional length of structure secured at no extra cost. The view shows a clear opening or waterway of 30 ft. whereas the total length of the structure lacks only 6 in. of being 50 ft. long.

For shorter openings, the length of the structure may become even more than double the length of the clear

span. With a gravel or selected material wearing surface similar to that on the roadway, placed on the slab or bridge proper, to all intents and purposes traffic is "on the bridge" as soon as it reaches the wing walls or rear ends of the side walls. This fact helps to overcome the unsightliness of short deep structures. A concrete hand rail extends the entire length of the side walls, which are in line with the curbs of the slab.

The ease of construction of this type of abutment is also to be noted. Cofferdams or sheetpiles are driven around the neat line of the footing only. The sidewalls should extend up to the point above water line before cantilevering back, thus effecting much economy in the cost of wet excavation. Horizontal buttresses are poured with the walls, an opening being left on top at a point farthest away from the walls to facilitate puddling or spading.

If any danger of scour exists which might get in back of the footing and carry out the roadway fill, sufficient rip-rap should be provided and placed in the exterior quadrants to prevent such an occurrence.

Swiss Technical Notes

The Post-War Financial Status of a Neutral Nation —Zurich's Municipal Participation in Winter Reserve Power Development

IN CONNECTION with the brief note in *Engineering News-Record*, Dec. 15, p. 999, concerning the budget of the United States of America, some comparison figures taken from the 1922 budget of the small country of Switzerland (population 3,900,000 on an area of 16,000 sq.mi.) may be of interest. The figures are well adapted to bring out how the after effects of the World War bear heavily even on a neutral country. Most markedly these effects appear in a sharp economic depression, affecting nearly all fields of industry.

The figures given below refer only to the regular governmental expenditures. They do not include the direct cost of mobilization during the war, whose separate balance sheet shows expenditures of about 1,200,000,000 francs, nor the corresponding profit-and-loss figures of the Swiss Federal Railways, which also are carried on separate books. The cost of mobilization, by the way, already has been covered to the extent of 50 per cent by war and profit taxes, but the balance of 600,000,000 francs is yet to be raised by future war taxes.

As the distribution of expenditures between the different branches of the government is of chief interest, the following tabulation of receipts and expenditures lists the several departments separately:

	Receipts	Million Francs	Expenditures	Million Francs
I.	Capital income	22.8	Interest and sinking fund	113.5
II.	General administration—clerical, federal court, and federal insurance court	0.3		3.7
III.	Departments			
	A. State	2.4		6.6
	B. Interior	1.3		26.7
	C. Justice and Police	2.5		6.7
	D. War	2.0		81.6
	E. Finance and Tax	170.3		25.0
	F. Public Welfare	4.0		36.2
	G. Post and Railway	210.9		225.1
IV.	Miscellaneous	5.7		3.5
	Total	422.2		528.6

Budget Deficit—A prospective deficit of 106.4 million francs appears, which is to be brought down to 100 millions through reduction of the bonus or cost-of-living allowances of government employees. It will be seen that the cost of the War Department is relatively very high; this includes the division of federal topography.

The Federal Technical College and Testing Laboratory are under the Department of the Interior. The year's expenditures for these two institutions (exclusive of the cost of extensive new buildings just being completed) amount to about three millions, against which there are receipts from fees and the like of about 900,000.

As already remarked, the formidable deficit of the budget gives an indication of how Switzerland also is in the grip of the general heavy industrial crisis. The principal cause of this crisis is the depreciation in exchange of the other states of the European continent, and the closely related stagnation of trade and industry. A prominent effect is that industrial unemployment has reached appalling magnitude, particularly in the fields of construction, wood-working, metals, textiles, and clock-making.

Unemployment—On Dec. 31, 1921, the whole of Switzerland had 142,937 unemployed (88,967 totally without employment, 53,870 only partly employed), against 137,561 on Nov. 30. The industrial canton of Zürich (population 536,000), which had 1,817 wholly unemployed persons in December, 1920, had no less than 7,322 unemployed on Dec. 31, 1921.

As emergency work for unemployment relief, building to the value of 42 million francs is to be carried out in Zürich, with financial assistance from communities, the canton—the latter alone is providing for this purpose a credit of 10,000,000 under the heading of employment and housing relief—and the federal government. This corresponds to about 1,200,000 days of labor, and thus would furnish a year's employment to about 75 per cent of the unemployed of the canton. Further, courses for the unemployed in trade and agricultural training were instituted.

In a specially gratifying manner the voters of the city of Zürich at the close of last year gave approval to the proposal of the city authorities for municipal participation in the Wäggital Power Co., or the "Aktiengesellschaft Kraftwerk Wäggital." This participation is in the amount of 20,000,000 francs, representing one-half the initial capital of the company. The support of this undertaking is likely to assist greatly in the relief of unemployment. Some data on the proposed plant are given below, taken from an interesting informative statement of the city authorities to the voters.

Stored Power for Winter Supply—For twenty-seven years past the project of the Wäggital development has been under discussion. The original plan, proposed by private parties, contemplated single-stage development with a storage reservoir of 18,600 acre-ft. The present plan is for a two-stage high-head development with a reservoir of 114,000 acre-ft. capacity, and the plant is to serve exclusively as a winter reserve. The reservoir, which at spillway level will have a surface area of about 1.6 sq.mi., will be large enough to impound the total precipitation even of a wet year and hold it for use at the time of maximum energy demand. The mean annual inflow to the reservoir amounts to only 87,000 acre-ft. Provision has been made to pump up 27,000 acre-ft. from the intermediate storage reservoir at Rempen, which lies about 795 ft. lower. The power required for this pumping, summer-

night power, will be surplus output of the low-pressure plants of the company, the "Nordostschweizerische Kraftwerke und Elektrizitätswerke der Stadt Zürich."

The plant will have an upper stage of 852 ft. gross and a lower stage of 637 ft. gross. With an annual consumption of 106,000 acre-ft. of water drawn from the reservoir, it will develop a total energy of 111.5 million kw.-hr. This total power is to be concentrated in the winter months, that is to say in the time of the maximum demand for energy and the greatest shortage in the low-head plants of the company. The plant capacity will be 140,000 hp., enabling it to develop the output stated within a period of 1,200 hr., chiefly in the months of November to March. The maximum fluctuation of water level in the reservoir under these conditions will be 148 ft.

The dam which will form the storage reservoir is to be a concrete gravity dam of 318 ft. maximum height (220 ft. height above valley bottom) and a volume of 280,000 cu.yd. Four years will be required for its construction, so the plant is likely to start operating in October, 1925. The contract for the dam construction was recently let to the two well-known Zürich concerns of A. Hatt-Haller and Ed. Züblin & Co., for 11,000,000 francs.

Municipal Supply and Consumption—Full development of the plant, including the pumping station, is expected to cost about 94,000,000 francs. While this might appear to mean a rather high price of current per kilowatt-hour, it is to be remembered that the power in question is high-value winter power. Further, the plant will bring about an improvement in the flow of the streams dependent upon it.

The Wäggital plant is only about 24½ miles distant from the city of Zürich. By its financial participation in the development, the city secures control of one-half of the total of 111½ million kw.-hr. production. How valuable this new winter source of supply will be to the municipal electrical supply of the city may be gathered from the fact that during the winter of 1920-21, for example, the city consumed between Oct. 1 and April 30 a total of 72 million kw.-hr., of which 51.5 million was furnished by municipal supplies while 20.5 million came from outside supplies. Growth of power demand, and heating demand especially, makes it necessary for the city to count on an annual increase of at least 2 million kw.-hr., so that in the winter of 1935-6 the city would depend on outside supply to the extent of 55 million kw.-hr., which will now be covered by the city's share in the Wäggital plant. The total electrical supply resources of the municipality then (1935) will be, counting the Wäggital plant and the existing Albula and Heidsee plants, 55+40+10 or 105 million kw.-hr. winter and peak energy.

By granting the necessary credit the city has given the best evidence of its efforts to maintain and increase the independence of the community in supplying its energy needs. The great efforts on the part of the city in the fields of gas, water, and electrical supply are brought out by the following table:

ZÜRICH MUNICIPAL PLANT VALUES (END OF 1920)

Plant	Original Cost	Write-off	Book Value
Gas works	26.4	15.8	10.6
Water-works	23.1	17.5	5.6
Electric supply system	57.1	17.1	40.0
Total	106.6	50.5	56.2

Construction of the Wäggital power plant by the joint enterprise of the city of Zürich and the "Nordostschweizerische Kraftwerke," one of the largest public utilities of Switzerland, is to be welcomed also for the reason that by its means the city's electrical supply is withdrawn from purely private interests and placed in the hands of the public itself.

New Railway Bridge Loading Under Discussion

Bridge Stresses Under Actual Traffic—Adequacy of Cooper Loading—New Composite Loading Proposed in Three Forms

IN AN elaborate study of bridge stresses under modern railway traffic, presented before the American Society of Civil Engineers at a meeting in New York on Sept. 6, D. B. Steinman advanced the conclusion that the Cooper system of loading is no longer adequate for safe and economical design, and proposed in its place a new conventional loading based upon the effect of the heaviest modern locomotives. Active discussion of the paper by the meeting indicated a remarkably general approval of both these points.

Dr. Steinman's paper, for whose details reference is made to the May issue of the *Proceedings* of the society, investigated the relation of the Cooper conventional loading system, developed in 1894, to present-day traffic weights by means of actual stress calculations under maximum freight trains. The results of the calculations were expressed in terms of the equivalent uniform load which would produce the same stress in a particular bridge member as the actual locomotive and train load. Seven of the heaviest locomotives in actual use in the United States were taken for comparison with the Cooper locomotives. By comparing their equivalent uniform loads it was shown that a bridge designed to Cooper's loading will be seriously deficient in certain members or else needlessly strong in others, by amounts of 15 to 35 per cent or more, so that logical designing is possible only when different Cooper loadings are applied to different parts of a bridge and to bridges of different span lengths. A new form of loading which would not have this defect was developed by the following process: The equivalent uniform loads corresponding to the seven different actual locomotives for various members of bridge trusses of various spans being compared, the heaviest figure for each point of comparison was selected, and the resulting maxima were compiled in a chart of equivalent uniform loads, similar in arrangement to a diagram published by the author in *Engineering News* of April 22, 1915, p. 780. An engine wheel arrangement of the Mallet type was then devised, with two groups of five driving axles, to give very closely the same stress effects as the composite maximum of the seven. This engine has 60,000-lb. axle loads in the forward group and 75,000-lb. axles in the second group. In combination with a train load of 6,000 lb. per lineal foot of track, this was called *M 60 loading*.

Two simplified modifications of this loading were also devised. One of these is a constant uniform load of 6,000 lb. per lineal foot with three concentrations of 90,000 lb. at 12- and 48-ft. spacing. The other is a formula for the equivalent uniform live-load for any bridge member so located that l_1 is the length of the

shorter segment of the influence triangle of that member, and l_2 the length of the longer segment. The formula is

$$q = 5{,}000 + 60{,}000 \frac{\sqrt{l_2}}{l_1 + l_2}$$

In view of the closely identical results of the three alternative loadings (M 60 engine; uniform load with concentrations; formula) Mr. Steinman proposed them for adoption according to the preferences of bridge engineers, indicating, however, that the third or formula method was preferable in his own opinion.

Widespread approval was given the author's proposals in the discussion, although there was also some dissent. Brief notes on some of the comments follow, the favorable views being given first:

Favorable Opinion

R. C. Strachan: The author's first method is preferable, and is an advance over the present loading. The second and third are useful as short cuts in design.

V. H. Cochrane: The proposal to use a formula is valuable and worth adoption. It is the best of the three methods despite the absence of a graphic picture such as is given by the M engine. A modification of the formula will make it fit the stress composite of the seven actual engines more accurately.

B. A. Worthington: A change from the Cooper loading is called for, to avoid waste of material in bridges. The M60 engine is the most desirable of the proposed loadings.

G. H. Gilbert: Cooper's E60 does not provide properly for modern traffic; it is heavy enough for trusses (over 100 ft.), but the floors need 15 to 20 per cent more. The A.R.E.A. has defended the Cooper system, but the argument is not satisfactory. The author's proposed loading is too heavy, but this should not conceal the inadequacy of the Cooper loading.

J. A. L. Waddell: The author has shown that the Cooper system should be abandoned. The proposed system is as good as can be evolved for design. The formula is far the best of the three methods; the engine should be used only as a picture of the loading.

G. Lindenthal: The proposed engine is preferable to the other two proposals. The subject is not as vexing as usually assumed, however. Meticulous accuracy is out of place in fixing a loading standard. Impact affects the question; it seems probable that heavy freight locomotives with their slow-speed impact produce less severe effects on bridges than lighter passenger locomotives with the impact due to high speed.

R. A. Caughey: The first method proposed is best; designers would probably not care to use a bridge loading so intangible as that expressed by a formula. On branch lines the train load rather than the engine controls the stresses.

J. C. Bland: Traffic changes became important with respect to bridge stresses when loads passed E40, Cooper's upper limit, and the E loading is inapplicable beyond this limit. Using different Cooper loadings for different parts of a bridge is not desirable. The abandonment of Cooper's loading for design beyond E40 and the early adoption of one of the author's proposals is desirable. The third one is preferred. The Cooper system should be retained for expressing the capacity of existing bridges, in which field it has been of incalculable service. For design, each railroad should consider its group of engines, form a composite and choose its M loading to correspond.

E. A. Stone: The reasons advanced for classifying the Cooper system as a relic of the past are beyond dispute. The author's first method is attractive, and with diagrams it becomes as simple as any.

H. C. Bird: The plan of specifying either E or M loading is attractive.

A. H. Fuller: The first method is preferable. A formula is not desirable for use unless it can be shown to be adaptable to rapidly changing future conditions.

C. T. Bishop: The loading formula is commendable. A committee should investigate the subject to make sure that the formula is the best obtainable.

Clyde MacCornack: Wheel concentrations should be used for floors and short spans without floors, and uniform loads for all other members. A formula may do for this purpose.

C. P. Disney: All three methods proposed have an advantage over the present method; the third seems the ideal one. For Canada, however, the limiting loadings can be taken care of by the Cooper system, and this is likely to remain true for many years.

H. B. Seaman: The Society's committee on bridge specifications found in the paper what it had hoped for, but finally decided on a double specification, E10 and M10. Probably the M system can be used for all designing beyond E50. Its introduction as quickly as possible is desirable.

C. A. Mead: The author's second method is specially attractive. A change in loading is greatly needed. Probably train loads now are at a maximum, while engine loadings are not.

H. C. Keith: Study of the effects of different engines on the bridges of the New York & New England Ry. long ago led to adoption of a uniform load of 4,000 lb. per ft. with 25 ft. of 3,000-lb. excess. Under modern conditions the author's loadings are worthy of serious consideration. But the fact that branch lines may get heavy trains with light locomotives must be considered.

Dissenting Opinion

C. D. Purdon: Not all classes of locomotives run over every railway, but all kinds of cars do, so that the fairness of specifying a maximum composite engine loading is doubtful. The typical engine proposed does not resemble an engine but is merely a load per foot, and the composite loading might be used as well. The M engine on 0.5 per cent grades would haul more cars than could be handled. The difference between the Cooper and the M loadings is partly one of unit stresses; the latter is practically the same as E60 increased by 25 per cent.

Albert Lucius: The present tendency is toward increased number of drivers rather than toward increased axle loads. It is preferable to specify the maximum local axle loads and spacing, the heaviest typical locomotive diagram, and the maximum train load.

J. M. Johnson: For large mileages in the South, Southwest, and parts of the West, conditions will for a long time limit engine weights. The author's loading proposals are in the right direction, but their application to the entire country is too radical, as there is a large mileage for which Cooper's loading will be satisfactory for a long time.

C. S. G. Rogers: If all the various locomotives used in the composite were used on any one railway the proposed M loading would fit the requirements admirably. As this is not the case, waste will not be avoided by the M60 system but a special loading needs to be developed by each railway for its needs.

O. H. Ammann: The author's data do not prove that the Cooper system is less representative than the proposed one for present traffic, not to mention steam and electric locomotives to be designed in the future. A standard loading may be based on the average service rather than the maximum, leaving the stress peaks to be taken care of by the margin in unit stress and the margin for future increase. A design prepared for the same loading under two different specifications showed greater differences in members than the author's comparisons of maximum engines with Cooper's. In view of the differences in stress effect of the actual engines studied by the author, can any standard give uniformly satisfactory results? Many of the discrepancies found between Cooper's and the actual trains disappear if an equitable combination of engine and train is taken, as 6,000-lb. train load with an E72 engine; the curve for this combination in fact follows the author's

composite curve more smoothly than does the M60 engine. Moreover, if engine and train weights increase at different rates, the M system will soon be as inconsistent as the Cooper.

C. E. Fowler: The Cooper system should be dropped, but in developing a new loading it is desirable to get together with the American Railway Engineering Association and the Engineering Institute of Canada. Some things that need to be done first are standardization of locomotives and reduction of counterbalance impact. A series of engine classes may be formulated after this is done, and future change of loading types and tables avoided. The lower impact of freight locomotives should receive consideration.

C. F. Loweth: Simplification of railway bridge loadings is desirable, but it is not obvious how far this can go at present. Past experience in growth of traffic weights and current increase in rail weights and solidity of track construction suggest the possibility of further increase of loads, but on the other hand a reaction may come, and present loadings may prove to remain the maximum. Electric locomotives will come in as a factor. Standardization of locomotives does not appear to be near at hand, and cannot be carried out at present. To get uniform results in bridge design it is necessary to do more than select typical locomotives; the maximum passenger and freight engines should be considered separately, running at their respective maximum speeds.

New Water Meter Rates for Detroit

INCREASED overhead operating and maintenance charges in Detroit due to the installation of filters which will go into operation early in 1923 and other recent improvements have made it necessary to revise the meter rates. Detroit is 99 per cent metered. The proposed rate is based on a service charge and a charge for water used. For a ⅝-in. meter the service charge will be $2 per year and for a 4-in. meter, $36. The use charge is 50c. per 1,000 cu.ft. for the first 100,000 cu.ft. and thereafter at the rate of 35c. per 1,000 cu.ft. A householder with a ⅝-in. meter using 1,000 cu.ft. or less per quarter will pay $4 per year, as at present.

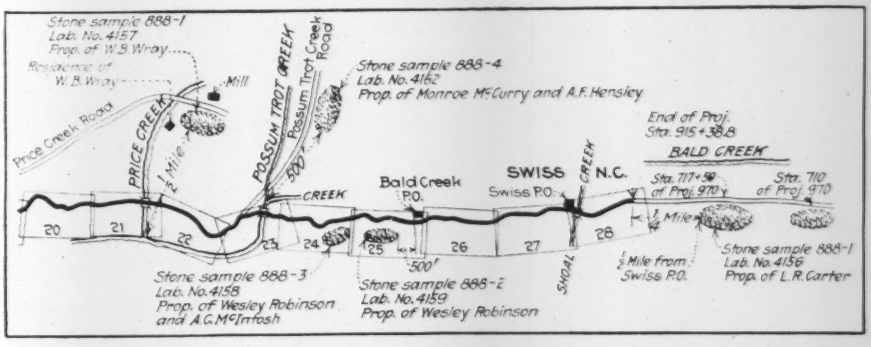
In determining the amount to be raised George H. Fenkell, general manager, Department of Water Supply, in an extended report to the Board of Water Commissioners analyzed the elements on which to base the rate.

The service charge was made to cover a part of the interest on capital invested, some return for the loss of water through the 5 per cent meter slippage and to prevent customers using too large meters.

To obtain a rate for the output charge the consumption of 6,877 meters was studied. Of these meters 15 per cent passed less than 1,000 cu.ft. per quarter, or 695 cu.ft., and 83 per cent between 1,000 and 100,000 cu.ft., averaging 18,827 cu.ft. In order not to make the charge less than the present $4 charge for the smaller meters, the use charge was set at 50c. per quarter for those using less than 1,000 gal. At 50c. per 1,000 cu.ft. the average amount of water used through the meters between 1,000 and 100,000 cu.ft. and the balance at 35c. gave the desired income.

Materials Survey Maps Aid North Carolina Road Contractors

SOURCES of materials suitable for road construction are indicated by the Department of Tests and Investigations in a "report" which accompanies the plans for every highway improvement project in North Carolina. As each project is developed for improvement, a materials survey is made. All local materials deposits are searched out; their location and extent are roughly determined, and representative samples are sent to the headquarters testing laboratory at Raleigh for determination. When the tests have been made a map of the improvement is prepared on which are recorded the acceptable deposits and other useful information as indicated by the portion of the map for Project 888 which is illustrated herewith. This map is bound into a folder which also contains a typed list of the deposits and another typed list of commercial materials plants within the State.



PORTION OF MATERIALS SURVEY MAP SHOWING DATA FURNISHED

The department does not guarantee the quantity or the continued quality of the deposits located but lays all its data open to the contractor for such use as he may or may not decide to make of it. With a map, which accompanies all plans for a project, showing adjacent railways and stations, the materials survey map gives the contractor a fairly complete notion of the supply and transportation conditions which he has to consider in preparing bids and plans for the job.

NORTH CAROLINA STATE HIGHWAY COMMISSION
DIVISION OF TESTS AND INVESTIGATIONS
RALEIGH, N. C.

Investigation of deposits of _____ (Stone—Sand—Gravel)
Name of property owner or operator _____
County _____ District No. _____
Available for Projects Nos. _____
Relative location of deposit _____
_____ Sketch No. _____
Sampled _____ (Yes—No) How many _____ Identifications _____
_____
Is material developed commercially? _____ (Yes—No)
Survey started _____ Survey finished _____
Quantity available _____ Cu. yds: Nature _____ (State Character)
Workable area _____ Average thickness _____
Amount stripping (Ave.) _____ Kind of material _____
Strata varies from _____ (Depth) to _____ (Inclined—Horizontal)
Give description of Quarry-Boulder-Ledge-Field stone. Sand: bank or Stream bed. If commercially developed and operated give size screens used-railroad-daily capacity, etc.

SURVEY PARTY REPORT BLANK

LETTERS TO THE EDITOR

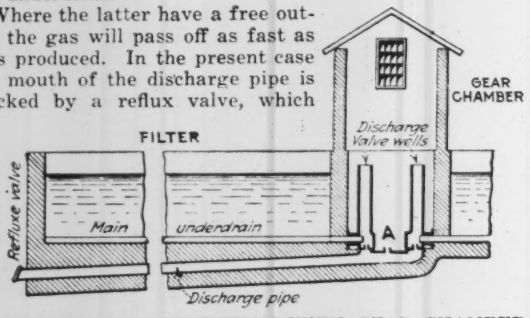
This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Sewage Filter Gas a Danger

Sir—One day last week an assistant of mine who was examining the alternating gear of a contact bed installation was attacked, and rendered nearly unconscious, by gas. The sewage-works manager stated that he had had similar experiences.

As to the origin of the gas there is of course no mystery. A sewage filter in the course of a day oxidizes a considerable amount of carbon, forming a corresponding volume of carbonic acid gas; and the latter, being heavier than air, sinks to the bottom of the filter and flows off through the underdrains.

Where the latter have a free outlet, the gas will pass off as fast as it is produced. In the present case the mouth of the discharge pipe is blocked by a reflux valve, which



UNDERDRAIN CONNECTION WITH GEAR CHAMBER

protects the filters from flooding during a high state of the brook which receives the effluent, the arrangement being as shown in diagram herewith; and the gas, being thus deprived of a free outlet, makes its way back into the chamber through the opening "A" provided for the drainage of the latter.

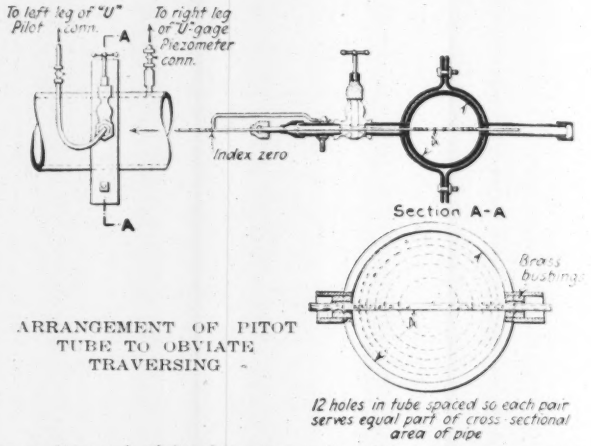
The same thing would happen in the case of a trickling filter having its underdrains converging in a manhole or inspection chamber the outlet from which is for any reason trapped. The gas which accumulates in such chambers may easily become a source of danger to men who have occasion to work in them. ARTHUR J. MARTIN.

London, England.
Aug. 15, 1922.

Pitot Tube to Obviate Traversing

Sir—A modification of the Pitot tube which eliminates the necessity of traversing the section to get a mean velocity by providing a dozen holes lengthwise in the tube with its end plugged was experimented with from May 1 to 15, 1922, by students at the Brooklyn Polytechnic Institute under the direction of Prof. H. P. Hammond. No reference could be found of the previous use of such a tube. I am submitting this in the hope that it may attract the attention of men who will carry the investigation further.

A ¾-in. extra heavy tube plugged at one end was used for the Pitot. The tube was tested on a 4-in. pipe. On a scratch line 4 in. long drawn on the Pitot tube (extended across the center of the pipe as shown in sketch) 12 ⅛-in. holes were so spaced that each served an equal cross-sectional area of the 4-in. pipe. That is, the two inner holes served the small inner circular area and each of the other five pairs of holes served a concentric ring. The end of the Pitot was connected to one leg of a U-gage and a piezometer connection three-fourths of a diameter upstream was made to the other leg of the gage. Pressure head


To left leg of "U" Pilot conn.
To right leg of U-gage Piezometer conn.
A
Index zero
A
Section A-A
Brass bushing
12 holes in tube spaced so each pair serves equal part of cross-sectional area of pipe

ARRANGEMENT OF PITOT TUBE TO OBVIATE TRAVERSING

was disposed of in this way and a direct velocity reading could be made on the gage.

To form a basis of opinion the velocity as found by the gage reading was compared with the actual velocity determined by measuring the discharge in a period of time and dividing it by the area of the section.

The tube was tested against a 19-ft. pressure head to suppress any velocity variation due to irregular pumping. The velocity ranged from 1.25 to 11.06 ft. per sec. at intervals of approximately 1 ft., the limit of error being −1.9 to +0.9 per cent. The tests were made at a 180° bend where the velocity distribution would be most irregular and at the end of a straight stretch where the distribution would be normal.

The gage fluid used had a specific gravity of 1.59 and it was found that at velocities less than 2 ft. per sec. the viscosity of the liquid affected the readings so that the limit of error for most of the work was well within ±1 per cent. This small limit of error would lead one to believe that, if this type of tube behaves in the same way for large and small pipes, a new way has been found to rate pumps and make similar water measurements. Until near the completion of the test, the inner circular area was served from a single hole in the tube. The limit of error was then 5 to 10 per cent. George W. Gebhardt, my colleague on the thesis for which the tests were made, suggested two holes to serve the central area, as already described, with the result already stated. WILLIS C. HANNING.

Brooklyn, N. Y.

Foundation Pressures in Multiple Arch Dams

Sir—My attention has only recently been called to the discussion of pressures on foundations which first appeared in your issue of April 13, and which has been answered by Mr. Noetzli and others.

Mr. Noetzli, however, admits that his formula is of no more use than the other, $f = P/A \pm MZ/I$, when the neutral axis falls inside the heel of the foundation. An exact analytical solution of the problem is possible, but the formula deduced will probably be so cumbersome as to make its use impracticable.

However, the problem can be solved by graphics in a very easy manner, as follows:

Divide the area into a convenient number of strips and compute the area of each strip.

Lay off the areas on the load line *o*—23.

Draw the equilibrium polygon *ABC*, and produce the line *AZ* corresponding to string *O-o*.

Drop a perpendicular through *P* to intersect the line *AZF* at *Z*.

From *Z* draw by inspection a line *ZBC* in such a manner as to make the shaded areas *AZB* and *BDC* equal to each other.

Drop a perpendicular from *E* to *C*.

Then the line *EC* is the neutral axis required.

Proof:

The stress varying directly as its distance from the neu-

tral axis.

$$f_x = Kx \tag{1}$$

where K is a constant.

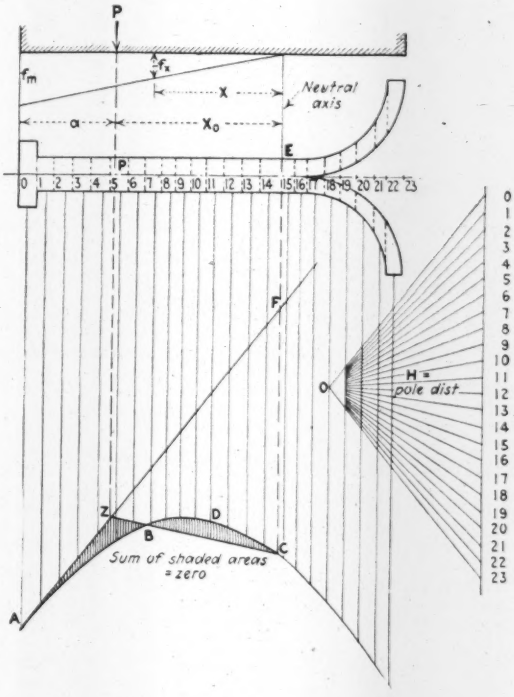
Summation of vertical forces = 0.

$$\int f dA = P \tag{2}$$

Summation of moments around neutral axis = 0

$$\int f x dA = P x_o \tag{3}$$

Eliminating f and dividing three by two



$$\frac{K\int x^2 dA}{K\int x dA} = x_o$$

whence

$$x_o = \frac{I}{S} \tag{4}$$

where I and S are the moment of inertia and the static moment, respectively of the area to the left of the neutral axis around the same axis.

By a well known principle of graphics the ordinate CF (Fig. I) multiplied by the pole distance H gives the static moment of the area to left of CF. Also the area $ABDCF$ multiplied by ZH = the moment of inertia of the same area about the neutral axis.

By making the area AZB = area BDC the area enclosed in the triangle ZFC = area $AFCDB$.

$$\text{Area } ZFC \times 2H = I;\ FC \times H = S$$

$$\text{Area } ZFC = FC \times \frac{x_o}{2} = \frac{S}{H} \cdot \frac{x_o}{2}$$

$$\frac{Sx_o}{2H} \times 2H = I \therefore x_o = \frac{I}{S}$$ as required by four

To find the stress at any point

From Eq. $2P = \int f dA = K\int x dA = KS$

$$\therefore K = \frac{P}{S}$$

$$f_x = Kx = \frac{P}{S}x \text{ and } f_m = \frac{P}{S}(x_o + a)$$

So much for a foundation that is symmetrical about its longitudinal axis. But suppose that it were not symmetrical. What then? This problem can also be solved by graphics in a manner almost as simple as the present, but the limits of this letter will not allow the demonstration here.

Brooklyn, N. Y., July 24. EDWARD TAYLOR.

In Defense of the Seattle A. A. E. Chapter

Sir—In *Engineering News-Record*, June 1, p. 893, there was an editorial entitled "Poor Professional Tactics" which evidently refers to one of the activities of this chapter. We heartily agree that it would be "poor professional tactics" for any engineering organization to have done what you have accused us of doing in this editorial. But in justice to our association and the individual members who compose it, we wish, in protest against the unmerited accusations, to deny absolutely ever having made at any time, and particularly in the instance cited by you, any charge of overpayment of engineering employees. Furthermore, we fail to see wherein a fair and just criticism of the administration of any project necessarily implies professional jealousy, and there was no such motive existing or expressed in our report—both members and non-members of our organization being involved in our criticism.

The editorial accuses us of charging gross overpayment of the men. Nowhere have we made any such charges. Under subject 3 of our original report, dealing with salaries, the findings of the committee explicitly state "that the men selected are capable men and are entitled to the salaries paid for their professional services. There is, however, a considerable difference between the salaries paid upon this city undertaking and the salaries paid for similar classification on other city work. . . . We believe that the city should be consistent in its treatment of its various employees and pay adequate salaries to all regardless of what project they may be engaged upon."

As to citing a $5,000 construction engineer as an example, the summary of the charges reads "The chief engineer, who draws a salary of $7,500 per year, has employed a construction engineer at $5,000 per year, when he himself is commonly supposed to be on the job in charge of construction and operating under the city engineer." There is nothing whatever in this statement that criticizes the salary of anyone; but there is a criticism of the employment of a second construction engineer at $5,000 (or any other salary) when there is already one on the job, and the last sentence in the above quotation explicitly states this. The so-called chief engineer was employed by the city as engineer in charge of construction at $7,500 per year, and under these conditions we do intimate that another construction engineer is a superfluity regardless of salary. We believe that in all fairness you should have so stated.

The American Association of Engineers is committed to a policy of active participation in civic affairs, and in the pursuance of such activity it is bound to receive opposition and criticism. We shall endeavor to profit by it, especially when it is just and friendly; but in no event will it deter us from pursuing the course laid out for attaining our aims and objects, which we deem most worthy. We wish to cooperate with all who are in sympathy with us in the effort to improve conditions not only for the engineering profession, but for the public generally.

Seattle Chapter American Association of Engineers,
GARRISON BABCOCK, President.

Seattle, Wash., Aug. 17.

[The statement of the motives of the Seattle Chapter is accepted without question but the impression made by the report itself remains. It is hard to see how anyone outside the engineering profession reading the report could fail to believe that the engineers making the report felt that the city's regular engineers, working at less than the $7,500 and $5,000 salaries paid the special engineers, could do the latter's work in addition to their own. While the report may have been intended to impress on the public consciousness that the regular city engineers should be paid more—certainly as much as the special engineers—it really leaves an impression of hopelessness of any such good fortune Editor.]

NEWS OF THE WEEK

New York, September 14, 1922

Federation Executive Board Meets at Boston

Opposes 12-Hour Shift in Industry—To Study Muscle Shoals Projects—Acts on 1926 Exposition

At its Boston meeting held last week, the executive board of the council of the Federated American Engineering Societies approved the report of its committee on work periods which finds in effect that the two-shift day of 12 hours each is not an economic necessity in American industry. The committee holds that the tendency throughout the world is toward the abolition of the 12-hour shift, that plants operating on an 8-hour shift basis are competing with 12-hour shift plants, and that in practically every major continuous industry plants which have changed from 8- to 12-hour shifts have increased the quantity of production per man to as much as 25 per cent. The steel and iron industry was made the subject of a special report, in which it was found that the "change from the 12- to the 8-hour day has secured results sufficient to compensate in whole or in part for the extra cost." Other advantages to be achieved by the change are better morale, elimination of the "floating gang" which is maintained to give 12-hour men a day off each week, and greater prestige of the industry with the public. The investigation has been carried on over a period of nearly two years assisted by the Cabot Fund.

To Study Muscle Shoals

The board authorized the appointment of a committee of engineers to study the Muscle Shoals problem and to submit to the committee on procedure and subsequently to the executive board an outline for an investigation which shall analyze the entire problem and lay its elements before the public for its information and guidance. It is planned to have this committee consist of disinterested and competent engineers who will serve without compensation. It is hoped that the result of the study will help to settle the controversy.

The executive board adopted also the report of the committee on reforestation, which approved plans to co-operate with other bodies that have the subject in hand; approved the universal contract form for building construction devised by the Department of Commerce, and appointed a committee to draft a bill that would incorporate the recommendations of American Engineering Council's committee on licensing of engineers. (See *Engineering News-Record* of June 15, 1922, p. 993.)

It was decided also that the federation would co-operate in the engineering program of the Sesqui-Centennial Exposition to be held in Philadelphia in 1926. It will undertake the presentation of a program dealing with the non-material and non-technical aspects of engineering practice and leave to the national engineering societies the technical subjects that may be considered.

The board adjourned to meet in Washington on Jan. 4, 1923, at which time the American Engineering Council will hold its annual meeting.

Los Angeles at Last Approves $12,000,000 Sewer Loan

A four-to-one majority approving the proposed $12,000,000 bond issue for building a new trunk sewer to the ocean was the result of the election in Los Angeles August 29. A favorable vote had been encouraged by sewer overflows in various parts of the city and active campaigning by city officials and interested citizens. A two-thirds majority was necessary to carry the issue. Votes were cast by about 60 per cent of the registered voters.

The new measure authorizes the city to "acquire and construct outfall sewers, main sewers, disposal plants, and treatment plants for the collection disposal and purification of sewage, together with the necessary machinery, apparatus and other property." Comment on the sewer situation and plans for relief appeared in *Engineering News-Record* April 13, p. 618; May 11, p. 806; May 18, p. 843.

Only about one-tenth the amount authorized by the bond issue is to be spent within the next year, it is stated. About $500,000 will be used to complete the temporary sewer to Culver City and the construction there of a treatment plant to clarify sewage before turning it into Ballona Creek. This work is to be rushed so as to have it completed before the winter rains would threaten the sewers that are already taxed to capacity. The temporary disposal plant at Culver City is to handle the excess flow of the present system for the next three years while the new outfall, screening and treatment plants are being built.

To Take Bids on New Water Supply for City of Memphis

Plans and specifications for contract No. 6 of the new well water supply for Memphis have been practically completed, according to a report from Fuller & McClintock, 170 Broadway, New York, and Produce Exchange Building, Kansas City, designing and supervising engineers for the project. This work comprises all the main grading at the Northern Parkway site, sewers, drains, concrete substructures of pump station and boiler house, and of the 18 m.g.d. iron-removal plant, together with the 10 m.g. covered concrete reservoir. It is expected that bids will be received on this work by the Artesian Water Department of Memphis about Oct. 9.

Brick and Lumber Industries Feel Effect of Strikes

In reply to a request by *Engineering News-Record* for information as to the present and probable effect of the coal and railroad strikes on the common brick industry the Common Brick Manufacturers Association of America has submitted the following:

"As a whole, the common-brick making industry of the United States, although it has been considerably retarded, has not up to this time been seriously affected by either the coal or the railroad strikes. The cost of coal due to the strike has of course increased very materially the cost of manufacture. Contracts at prevailing rates made before the strike were not fulfilled, and manufacturers were fulfilled, and manufacturers often had to pay a 100-per cent increase over contract price.

"The effect has been different however in various sections of the country. In some, coal has been scarce and has retarded the intensive manufacture which the demand for brick induced; but comparatively few plants have actually been closed for lack of burning materials. Some plants have turned from coal burning to other materials or processes on account of coal shortage but with very little delay or retarding of manufacture. Some central western manufacturers were affected by rail transportation in shipping their output to other markets than their own, but in a very large degree home consumption this year has been so large that shipping has not been a serious factor with the producer. Furthermore, trucks are now being used to transport brick within a radius of fifty miles of their production point."

A similar inquiry addressed to the National Lumber Manufacturers Association elicited the following:

"The lumber industry is not dependent on coal because it has its own fuel supply. It will of course suffer from impairment of other industries dependent on coal. Probably at least $10,000,000 loss will result from continuation of car shortage another sixty days."

The National Paving Brick Manufacturers' Association reported as follows:

Coal and rail strikes naturally offer some obstruction to paving brick industry. Up to the time of strikes the industry was on the way to the best year in point of total output it has had since before the war. In fact the demand for brick pavements was brisker than ever and the demand remained at this high point during the most of the strike situation. Shipments are now gradually increasing from the low point of two weeks ago. The industry is beginning to secure coal at prices which permit of production if not profitable production; and various plants which shut down for lack of fuel are resuming operations. In the North, lack of fuel was the greatest handicap and in the South, lack of transportation.

Seek Rehearing of Coronado Suit Against United Mine Workers

Washington Correspondence

Petition for rehearing of the so-called Coronado coal case, in which the United States Supreme Court on June 5 handed down a noteworthy decision holding that labor unions, although not incorporated, are suable and liable for damages resulting from acts of their members on an authorized strike in matters affecting interstate commerce, was filed with the court Thursday in behalf of the Coronado Coal Co. and others, plaintiffs in the original suit against the United Mine Workers of America.

The Supreme Court, while rendering a broad opinion in the case and establishing a new principle of legal procedure against labor unions, held that it could not sustain the award of damages to the original plaintiffs because it had not been established to the satisfaction of the court that the acts complained of were in restraint of interstate commerce during an authorized strike, and expressed regret that this was so.

In the petition for rehearing, the petitioners set forth that, "encouraged by the statement with which the court closes its opinion, and believing that the court will recognize the ready possibility of error in drawing inferences of fact from a record so voluminous and complicated, petitioners venture to assert that the decision of the court debarring petitioners from recovery in the present action is founded upon essential mistakes and misconceptions of the facts presented by the record."

The Supreme Court will act upon the petition for rehearing after it reconvenes Oct. 2.

Federal Reorganization Plan Not Abandoned

Washington Correspondence

There has not been the slightest surrender on the part of the administration of its intention to bring about practical reorganization of the executive departments of the federal government. A tentative report was laid before the President several months ago. It has not been made public due to the fact that the report as submitted is not acceptable to all of the department heads. It is believed, however, that certain changes in the plan can be made so as to secure for it the unanimous support of the department heads or at least any dissenting opinions that may be offered will be of minor importance.

Were the report to be sent to Congress without the endorsement of certain of the department heads, it is recognized that the possibility of securing the legislation would be lessened. Moreover the legislative situation, since the report was submitted to the President, has been such as to preclude action on reorganization. In addition if the report were made public in its tentative form and before unanimous endorsement by department heads had been secured, there is a feeling that it would invoke non-constructive criticism and arouse agitation which would serve no good purpose.

It can be stated authoritatively that the reorganization proposal has not been laid aside indefinitely.

The Engineer in Public Life

R. M. HOSEA

While he has never held public office Raphael M. Hosea, consulting engineer of Denver, Colo., through his advocacy of city zoning has shown his fellow engineers the way to genuine public service. This phase of modern city development is not readily understood by the average citizen and demands much pioneer work of a promotional type..

Beginning by interesting a small group of representatives of various Denver civic organizations, Mr. Hosea, as chairman of the Civic Affairs Committee of the Colorado Society of Engineers, presently had many converts to city zoning. At the opportune time the Denver City Planning Commission was organized. Its members were soon shown the advantage of the zoning plan outlined by Mr. Hosea and they made him chairman of the committee to work in the furtherance of this plan.

Mr. Hosea, many years chief engineer of the Colorado Fuel & Iron Co. and its railroad subsidiaries, has included in his consulting practice irrigation, railroad, coal mining, and water supply. He was born Sept. 13, 1857, at Cincinnati, and received the degree of B.S. in Civil Engineering at the Massachusetts Institute of Technology in 1879. He is a member of the Western Society of Engineers and is now president of the Colorado Society of Engineers.

Public Health Association to Meet in Cleveland

The fifty-first annual meeting of the American Public Health Association will be held at the Hotel Statler, Cleveland, Oct. 16-19. Besides the general session there will be the usual meetings of the various sections, including those on sanitary engineering, laboratories, vital statistics, public health administration and others. The program of the sanitary engineering section will consist largely of committee reports, of which the following have already been scheduled: "Mosquito Extermination," M. Z. Baer, chief engineer, Arkansas State Board of Health; "Bathing Places," C. W. Simonds, Jr., chief engineer, Florida State Board of Health; "Refuse Collection and Disposal," M. N. Baker, of the editorial staff of *Engineering News-Record;* and "Milk Supply," H. A. Whittaker, director, Division of Sanitation, Minnesota State Board of Health. There will also be a paper on sludge disposal by Langdon Pearse, sanitary engineer of the Sanitary District of Chicago.

A feature of this year's exhibit will be a "co-operative book store" in which it is stated that "the leading general publishers and all the most important medical publishers of the country" will participate.

Rail Injunction Continued for Ten Days

Shopmen Consider Peace Plans While Railroads Embargo Freight and P. R. R. Clerks Talk Strike

Following the first day's hearing on Attorney General Daugherty's petition for an injunction against the striking railroad shopmen, and their union leaders, the temporary injunction granted by Federal Judge Wilkerson was continued in effect not to exceed ten days. This will extend the order to Sept. 21.

Representatives of the strikers were denied their motion that the petition be dismissed, but in the course of the argument over the continuance of the restraining order, the Court indicated a possibility that some modification of the present order might be made. The defense protested that some of the statements of the Department of Justice with regard to incidents arising from the strike were inaccurate, but they were admitted as evidence on the understanding that further facts would be adduced in their support. In view of the continuance of the injunction, argument will be offered at once as to a modification of the penalties.

Shopmen Discuss Peace

Meanwhile, reports from Chicago indicate that the policy committee of the striking shopmen are discussing proposals for a settlement of the strike. Much mystery is made as to the nature of the propositions in hand and every precaution appears to have been taken to prevent a leak.

The New York Central, Erie, Lackawanna and Lehigh Valley Railroads have placed an embargo on freight for the announced purpose of throwing all available equipment into the handling of anthracite coal for New York. These four roads have banned from their lines all freight except foodstuffs. This will not interfere with local freight, but applies only to that received from other roads at western connection points.

Union leaders have announced their intention of calling a strike of the clerks, freight handlers and station employees of the Pennsylvania R.R. Ballots are to be mailed at once, and action is expected within the next ten days. Such a walkout would affect about 30,000 men.

Lawsuit Delays Moffat Tunnel

Progress on the Moffat tunnel through the Rocky Mountains is held up pending an action to determine the legality of the enabling legislation. Meanwhile, Maj. L. D. Blauvelt, chief engineer of the tunnel commission, has again assumed his duties as state highway engineer, from which office he took leave of absence to supervise the preliminary tunnel work. It is announced that Maj. Blauvelt will give the tunnel commission such service as it may need until it is ready for construction.

Conference Amends Bonus Bill

The joint House and Senate conference has taken from the bonus bill the provision for free ports and land reclamation as described in *Engineering News-Record*, Aug. 24, p. 330, and Sept. 7, p. 410.

Municipal Improvement Society Meets at Cleveland Oct. 2-6

Many committee reports on paving specifications and other topics in the municipal field and a large number and variety of technical papers are scheduled for the twenty-eighth annual convention of the American Society for Municipal Improvements that will meet at the Hollenden Hotel, Cleveland, Oct. 2-6. Some of the reports and advance copies of some of the papers, as well as the lengthy program, may be obtained from Charles Carroll Brown, secretary, St. Petersburg, Fla.

There will be joint meetings on the evenings of Monday and Tuesday, Oct. 2 and 3, with the Ohio State Conference on City Planning, whose annual convention will be held at the same time and place as that of the Society for Municipal Improvements. Monday afternoon will be devoted to sectional meetings to discuss changes in the standard specifications already submitted or to be submitted to the society. It is expected that these meetings will be continued Monday evening.

Refuses to Pass on Bridge Case

The Port of New York Authority has declined the invitation of the War Depatment to act as umpire in a controversy between Newark, N. J., and the Central Railroad of New Jersey over the construction of a new bridge across Newark Bay between Bayonne and Elizabethport. The representatives of the city of Newark had objected to approval of plans of the railroad for a bridge to replace its present timber structure, although congressional authority for the bridge replacement has been granted, as the city wants Newark Bay freed of bridges in order to attract shipping to the bay. The War Department, which ordinarily acts upon its own judgment in cases of conflict between bridge and navigation claims, has twice referred the question to other bodies, first to the New Jersey State Board of Commerce and Navigation and more recently to the Port of New York Authority. The opinion of the former board was adverse to approval of the plans of the railroad company for the new crossing.

Coal Industry Settling Down to Meet Heavy Demands

Following the ratification by the tri-district convention of the anthracite miners of the agreement negotiated by the United Mine Workers and the operators, about 90 per cent of the 155,000 striking miners are expected to resume work at once. The remainder will follow as soon as those mine properties which have deteriorated during the shutdown can be overhauled.

It is expected that at the start some labor shortage will prevail and that full production cannot be counted on for several weeks. The companies, it is estimated, have in hand orders for at least 20,000,000 tons. Normal anthracite production is about 2,000,000 tons per week.

Last week the output of bituminous coal was about 8,500,000 tons. An output of 9,000,000 tons per full week may be expected, but transportation facilities are still the key to coal distribution.

S. L. F. DEYO

S. L. F. Deyo, whose death was noted in the columns of this journal last week, was one of the pioneers in subway construction work in New York City. From March, 1900, to June, 1905, as chief engineer, he organized the engineering department of the Rapid Transit Subway Construction Co. for John B. McDonald, and supervised the subletting of all contracts on both Contract 1 and Contract 2.

The work comprising Contract 1 was all the subway work extending from City Hall station to 231st St., what was then the Broadway line, now known as the Seventh Avenue line; and from City Hall station to the Bronx on the East side. Contract 2 included all the work from City Hall station to Atlantic Ave., Brooklyn. Mr. Deyo had supervision of all this construction work until his resignation from the company in June of 1905, at which time the subways were in operation from South Ferry to 157th St. and to West Farms.

Mr. Deyo was a graduate of Union College in the class of 1870. During the two years after his graduation he was engaged in survey work in Morrisiania, N. Y. From 1871-73 he was engaged on survey work and as resident engineer on the Harlem River branch of the New York, New Haven & Hartford R.R. For the next three years he was assistant engineer on the Fourth Ave. improvement work, New York City.

Railroad Record

After five years as superintendent of the American Metaline Co., of New York City, he became division engineer of surveys for the South Pennsylvania R.R. in 1881. During the next four years, he was engaged in survey work for the South Pennsylvania R.R., and on its construction, during which time he served as resident engineer. In 1886 he became principal assistant engineer of the Buffalo & Geneva R.R. and then assistant engineer of the Lehigh Valley R.R.

In 1887 he was engaged in railroad reconnaissance work in Northern Alabama for the Pioneer Mining & Manufacturing Co. He returned to the New York, New Haven & Hartford R.R. in 1888 as assistant engineer, serving in that capacity until his association with the Rapid Transit Subway Construction Co.

He also served from 1903 to 1905 as the chief engineer of the subway division of the Interborough Rapid Transit Co. while chief engineer for Mr. McDonald. Resigning from the Rapid Transit Subway Construction Co. in 1905, he joined the Interborough Metropolitan Co. as its chief engineer, a position which he occupied for two years. From 1908 to 1913 he was again chief engineer of the Rapid Transit Subway Construction Co., and from then until his retirement in 1918, engineer of the Interborough Rapid Transit Co.

Am. Soc. C. E. to Discuss Water Power at San Francisco

The water-power problem will be the feature topic of technical discussion at the fall meeting of the American Society of Civil Engineers to be held at the Palace Hotel, San Francisco, Oct. 4-8. Formal papers are scheduled as follows for the session of Oct. 4: Colorado River development, by Arthur P. Davis; new development at Niagara Falls, by Frederick A. Gaby; New York State water power, by John P. Hogan; the Federal Water-Power Act, by Oscar C. Merrill; aerial photography, by Gerard H. Matthes.

For Oct. 5 the papers will be devoted principally to Pacific Coast water-power subjects, the authors being Frederick H. Fowler, John D. Galloway, F. W. Peek, Jr., Harris J. Ryan, and Harry W. Dennis. Charles F. Loweth will discuss hydro-electric development in its relation to railroad electrification, while Prof. Charles D. Marx will deal with the social and economic aspects of hydro-electric power.

The local committee on arrangements, headed by A. H. Markwart, has arranged a number of excursions including trips to Hetch Hetchy, the Don Pedro dam, and the Yosemite Valley.

Railroad Merger Hearings to Be Resumed in West

Washington news dispatches forecast that the Interstate Commerce Commission hearings on the plans for consolidation of the railroads into a limited number of systems may be resumed the latter part of October. Hearings held so far have made practically no progress, as no company has approved a plan that would include itself except in the case of the proposed union of the Louisville & Nashville, the Nashville, Chattanooga & St. Louis, and the Atlantic Coast Line. In this case there is already a community of interest by stock ownership. It is expected, therefore, that the hearings will be shifted to the western district and that discussion will hinge largely on the disposition of the Central Pacific. This road is now owned by the Southern Pacific, but in a recent decision of the United States Supreme Court this ownership has been held to be in violation of the Sherman law. A movement is afoot to have the Central Pacific incorporated into the Union Pacific System which now ends at Ogden, Utah, from which point the Central Pacific handles its traffic to the coast.

Federal Bill to Control Coal Prices Passes Senate

The Senate has passed the bill urged by the administration to establish federal control over coal distribution and prices. Several amendments by Senator Borah designed to shape the fact-finding commission to conform to the agreements between the anthracite operators and the miners were adopted. These required that a separate report should be made on the hard-coal industry and that it should be presented to Congress not later than July 1, 1923.

In view of these amendments, the Senate bill will now go to conference in order that the differences between it and the House bill may be adjusted.

Hydro-Electric Matters Discussed by Canadian Engineers

Hydro-electric developments in the Province of Manitoba constituted the major part of the general professional meeting of the Engineering Institute of Canada at Winnipeg on Sept. 5 to 7, but the social events characteristic of the institute's meeting were not absent.

After an address of welcome from Mayor Fowler, institute affairs were discussed for an hour, the meeting recommending to Council the adoption of the report of the Committee on Policy. The hydro-electric development of the Province of Manitoba formed the theme of the first day's sessions. A paper on the Winnipeg hydro-electric plant was given by E. V. Caton, and the Manitoba Power Company's development at Great Falls was described by F. H. Martin. As guests of the City of Winnipeg, and the Manitoba Power Co., Ltd., about 275 engineers were conveyed by special train to the new Great Falls development of the Manitoba Power Company and the civic plant of the City of Winnipeg at Point du Bois.

Inspect Hydro-Electric Plants

The total development at Great Falls provides for six units to develop 168,000 hp. The initial development, however, provides only for two units. The turbines of single runner vertical shaft diagonal or propeller type will develop 28,000 hp. when operating under a head of 56 ft. and running at a speed of 138.5 r.p.m. The generators will be 21,000 kva. capacity, of the vertical type, generating three-phase sixty-cycle, alternating current at 11,000 volts. The transformers will be 7,000 kva. each single phase, water-cooled, 11,000/63,500/110,000. It is expected to have one unit installed this year. The City of Winnipeg's plant has a present capacity of 68,200 hp. and an ultimate capacity of 112,000 hp. It is located 78 miles from Winnipeg, and has a normal fall of 46 ft. The transmission line includes four circuits on two steel tower lines, all aluminum cable.

Thursday's program included the following papers: "Notes on the Construction of the Moncton Yards and Engine Facilities," by S. B. Wass; "Automatic Grain Car Unloaders for the Canadian National Railways at Port Arthur," by Fred. Newell; "The Fuel Values of the Coals of Alberta," by G. R. Pratt; "Highways in Western Canada," by M. A. Lyons; "The Chemistry of Portland Cement and Its Disintegration by Alkaline Ground Waters," by Prof. T. Thorvaldson, and "Twenty-eight Thousand Horsepower Turbines for Great Falls Development, Manitoba Power Company," by Geo. E. Bell. In connection with his paper, Prof. Thorvaldson gave an outline of the work of the institute's committee investigating the disintegration of concrete by alkaline waters.

The social functions included a luncheon on Tuesday as guests of the Association of Professional Engineers of the Province of Manitoba, and a dinner, the hosts being the Manitoba branch of the institute. On Wednesday, the Manitoba Power Co. were hosts at a luncheon, and the City of Winnipeg Hydro-Electric System for dinner. Again on Thursday the City of Winnipeg entertained at a luncheon at Assiniboine Park, and in the evening a banquet was held at the Fort Garry Hotel. At this banquet the Hon. W. R. Clubb, the new Minister of Public Works of the province, announced that Manitoba was planning a highway program that would place the province in as good a position as Ontario or Quebec.

Urge $75,000,000 Highway-Bond Issue in Tennessee

Sponsored by the Tennessee Good Roads Association, a movement is under way for the authorization of a $75,000,000 bond issue to complete the state highway system of Tennessee. The proposed state bond issue would be issued against an anticipated capitalized fund of $4,900,000, to be raised by combining the present federal-aid and state money with all of the motor-vehicle taxes and by an additional fund of $800,000 to be realized by a tax of 2c. per gallon on gasoline.

According to Morgan T. Nailling, secretary of the Good Roads Association, the bonds would be issued serially at the rate of $10,000 000 per year for a period of 7½ years, the roads to be completed during this period. The bonds would be retired serially at the end of thirty years from the date of each issue.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.
AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.
AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.
AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, San Francisco, Oct. 4-9.
AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Convention, Cleveland, Oct. 16-19.

The Western Society of Engineers opened its fall schedule of meetings, Sept. 6, with a paper on "Surveying with Aircraft Photographs" by Major James W. Bagley, Corps of Engineers, McCook Field, Dayton, O. On Sept. 11 John B. Hittell, engineer, the Asphalt Association, Chicago, spoke on "Asphalt, Its Occurrence, Production and Use in Highway Construction." For Sept. 18 Albert A. Northrop, Stone & Webster, Inc., Boston, will describe the Caribou hydro-electric development and Sept. 25 H. J. Burt will speak on "Stadium Design as Illustrated by the Grant Park (Chicago) Stadium." On Oct. 2 Jacob L. Crane will present a paper on "City Planning."

The Ft. Worth Chapter, A.A.E., will hold its next meeting Oct. 6 at the Chamber of Commerce when K. Robey, engineer for Ft. Worth Improvement District 1 will speak on water conservation and flood control.

The Engineers' Club of Kansas City held its first fall meeting Sept. 8, at the University Club. Its principal speaker was E. M. Johnston, the district manager of the American Rolling Mills Co., Middletown, Ohio, who talked upon the manufacture of ingot iron and special steel sheets, the talk being illustrated by motion pictures.

The Society of Industrial Engineers will hold its annual convention and exhibition at the McAlpin Hotel, New York City, Oct. 18 to 20, inclusive.

The Roadmasters Association announces that because of the railroad strike it has changed the date of its meeting at Cleveland from Sept. 14-21 to Nov. 21-23.

Personal Notes

E. J. Richmond, of Waterbury, Conn., has associated with Dwight E. Smith, engineer, New Haven, Conn., and the firm name hereafter will be Smith & Richmond.

L. J. Reese, county engineer of Dickinson County, Kan., has resigned and has accepted a position with a bridge-construction contracting firm engaged for the most part in building federal-aid bridges in Illinois.

J. Burdette Brown, who for the past several years had been connected with the state Department of Engineering on irrigation work, has resigned that position to join the extension department of the University of California at Berkeley.

Maj. James C. Long, until recently connected with the Tarrant County Highway Dept., Ft. Worth, Tex., reporting to R. V. Glenn, has re-entered the local office of U. S. Bureau of Public Roads. His permanent station will be at Baton Rouge, La. Formerly he was located at Albuquerque, N. M.

C. H. Teasdale has been appointed county surveyor for Johnson County at Cleburne, Tex. Formerly he was assistant engineer in the Johnson County Highway Dept.

Dr. J. W. Beede has resigned as geologist for the Bureau of Economic Geology and Technology, University of Texas, at Austin, to become geologist for the Empire Gas & Fuel Co., Bartlettsville, Okla.

J. E. McAnnally of Austin, Tex., has been appointed assistant U. S. irrigation engineer for work in the lower Rio Grande valley to succeed P. H. Clements, resigned. He will report to U. S. irrigation engineer R. G. Hemphill.

M. P. Tucker, former service director for the City of Akron, Ohio, on Sept. 1 was sworn in as city manager. He succeeds H. C. Campbell, who resigned to accept a position with the Firestone Tire and Rubber Co. W. F. Peters, former assistant director of the state highway department, takes Mr. Tucker's place as service director.

R. C. Bailey has recently resigned his position as business manager of the American Association of Engineers and is now with the Federal Electric Co. as sales engineer of multiphase and renewable fuses in the Philadelphia district.

G. H. ZAHNER, of Spokane, Wash., until lately at Orient, Wash., has entered the employ of the Delivuk-Orrino Engineering and Construction Co., Spokane, as engineer and estimator.

SUMNER D. BACON engineer with Ft. Worth & Denver is now engaged in building the Wichita Valley extension to Waureka, Okla.

NOEL OGILVIE, director of the Geodetic Survey of Canada, has left for British Columbia to visit the engineers now engaged in extending an unusually long arc of triangulation along the British Columbia coast. This work is being carried on in conjunction with the United States Coast and Geodetic Survey.

W. J. K. SKILLICORN, chief tariff officer of the South African government, is traveling through Canada for the purpose of obtaining first-hand information as to the system under which grain elevators are operated in conjunction with the railways and steamship lines.

R. L. BURWELL, formerly a specification aid in the United States Naval Experimental and Research Laboratory, is now manager of the statistical department of J. A. W. Iglehart & Co., investment bankers of Annapolis, Md.

JAMISON VAWTER, formerly assistant professor of mechanics at the University of Kansas, has been appointed assistant professor of civil engineering at the University of Illinois. Prof. Vawter has had several years general railroad engineering experience and was a captain in the Engineer Corps, U. S. Army, in France.

A. E. COWELL recently resigned the office of county surveyor of Merced County, Calif., to give his entire time to the engineering and architectural firm of Mayo, Cowell and Bissell of Merced and Stockton, Calif. The firm now occupies new offices in the Bank of Italy Building, Merced.

IVAN VALLEC, chief engineer of the Quebec Department of Public Works, has been appointed consulting engineer for the provincial government of Quebec.

CHRISTOPHER HARRISON, present mayor of Everett, Mass., is to assume the post of superintendent of public works and town manager of Lexington, Mass., on Oct. 1. Before becoming mayor of Everett Mr. Harrison was its city engineer. He was chosen from among 75 applicants.

HARRISON F. GONNERMAN has joined the staff of the Structural Materials Research Laboratory, Lewis Institute, Chicago. Mr. Gonnerman graduated from the Engineering College of the University of Illinois in 1908; from 1908 to 1914 he was assistant and instructor in the College of Engineering, University of Illinois; 1914 to 1920, research associate in the Illinois Engineering Experiment Station on experimental studies of concrete and reinforced concrete under the direction of Prof. A. N. Talbot. During the past two years he has been in business in Los Angeles.

OBITUARY

JAMES G. CHALFANT, for the past 15 years county engineer of Allegheny County, Pa., died at his home in Wilkinsburg, Pa., Aug. 26, aged 53 years. Mr. Chalfant had been a resident of Pittsburgh for 30 years, and had been prominently identified with many of the larger municipal projects, such as the bridge over the Allegheny river at Hulton station, the Sewickley bridge over the Ohio River, and the Monongahela river at Monongahela City. Besides being a member of the Engineers' Society of Western Pennsylvania, he was a member of the American Association of Engineers, and Pittsburgh Chamber of Commerce.

R. W. POWELL, civil engineer of Toronto, recently was found dead from a gunshot wound at Milltown, Bay D'Espoir, Newfoundland. Mr. Powell came to Newfoundland about a month ago in charge of a survey party in connection with a project for timber and water development at Bay D'Espoir. A rifle was found near the body and an investigation has been ordered.

THOMAS B. BRYSON, vice-president of the Holbrook, Cabot & Rollins Corp., died at his home in New York on Sept. 5, after a brief illness. A more extended account of his work will appear in an early issue.

From the Manufacturer's Point of View

Construction Material Deliveries Curtailed by Car Shortage

Contractors, equipment manufacturers, and producers of construction materials are all feeling the combined effect of the railroad and coal strikes. Due to the shortage of cars, deliveries of cement and aggregate have necessarily been curtailed, with the result that a portion, at least, of the work planned for this season has been held up. This condition, according to the views expressed by L. R. Burch, assistant to the president, Atlas Portland Cement Co., in an interview with *Engineering News-Record's* representative, has been more pronounced in the South and West than in the East. In the roadbuilding and general construction field it seems likely that a sizable volume of work scheduled for 1922 will have to go over until next year.

Contractors, of course, have been among the first to suffer from the reduced deliveries of materials, and the uncertainties attending their programs have been passed on to manufacturers of equipment who have been deprived of the volume of business in new plant which would have been theirs if outside influences had not been operating to reduce progress. One large manufacturer of construction plant in the Middle West estimates that orders totaling $110,000, definitely in prospect before the strikes started, have been lost or, at least, postponed. This particular manufacturer is a large producer of concrete and roadmaking machinery, so that in his business, as in that of practically all other construction plant manufacturers, the regular delivery of cement and aggregate is vital.

The Atlas Portland Cement Co., one of the country's largest cement producers, with groups of plants located at Hudson, N. Y., Northampton, Pa., Leeds, Ala., and Hannibal, Mo., has been unable to secure enough cars to handle its output. In the East, according to Mr. Burch, comparatively little trouble has been experienced in getting cars, but in the southern and western districts during the past two months only from one-half to two-thirds of the necessary number of cars could be secured. While this situation is attributable largely to the railroad shopmen's strike, the fact that crop movements have made a demand upon railway equipment also must be taken into consideration. On the whole, Mr. Burch believes, the railways have done everything that could be expected to meet the situation.

OPEN-TOP CARS NO HELP

Box cars are the only satisfactory means of shipping cement. It is true that in 1920 the Atlas Co. made a number of shipments in open cars, and as a result of this experience this method will not be resorted to again except in case of extreme necessity. The cement producer, Mr. Burch pointed out, is in much the same position as the coal operator in that he must meet a widely fluctuating seasonal demand for his product. Last December, for example, the Atlas shipments totaled 400,000 bbl., while in August 1,400,000 bbl. were delivered; the latter quantity, however, was considerably short of what the company considered it should have been. Normally, the heaviest cement shipments occur in the fall, so that a continuation of the car shortage will be a serious factor in maintaining construction schedules. For this year, at least, Mr. Burch sees no prospect of improvement in the car supply. However, he emphasized the fact that construction work not done this season will merely be delayed—not abandoned—and by carrying it over into 1923, together with operations already planned for next year, a tremendous total of work, calling for material and equipment in large volume, is in prospect. Motor trucks, in Mr. Burch's opinion, offer no real solution to the cement delivery problem as a whole.

Since the coal strike started April 1, cement manufacturers have had difficulty in securing sufficient quantities of suitable coal except at prices considerably above the normal market, and none of the cement companies has found it possible to operate without interruption. About 200 lb. of bituminous coal are required for the manufacture of one barrel of cement. A dollar a ton added to the price of coal, according to Mr. Burch, means a ten-cent per barrel increase in the manufacturing cost, and since the beginning of the strike the price of coal has been from $4 to $6 per ton above the normal previous cost. Due to the combined effect of car shortage and coal shortage the cement companies have been unable to carry out their plans for this season's production or to deliver promptly what cement they have been able to manufacture. In spite of these difficulties, Mr. Burch said, the Atlas Co. has been able to keep practically every job served by its product running.

BUSINESS NOTES

After May 15 the New York office of JOHN R. PROCTOR, INC., constructing engineers, is to be consolidated with the main office at Bayonne, N. J.

ALLEN ASHLEY, for 10 years associated with the domestic sales department of the Westinghouse Electric & Manufacturing Co. and for 4 years with the foreign sales department of the Allied Machinery Co. of America, has established a clearing house to handle surplus machinery and supplies at 152 West 42nd St., New York City. In addition to his service in the sale and purchase of surplus machinery, Mr. Ashley announces facilities for the storage of equipment in a New York warehouse where it can be shown to foreign and domestic buyers.

THE TRAYLOR ENGINEERING & MANUFACTURING CO., Allentown, Pa., has removed its northwestern district office from the Mohawk Building, Spokane, Wash., to the Alaska Building, Seattle. It is believed the best interests of the company will be served by the change inasmuch as the district office will then be nearer to the mining interests of the extreme northwestern United States, British Columbia and Alaska.

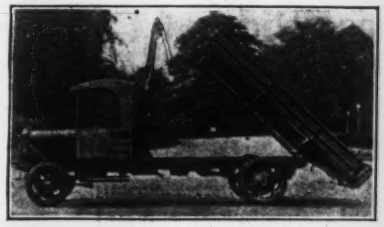
THE LOWER ST. LAWRENCE POWER CO. has been organized to develop electrical energy from the Grand Metis Falls on the Metis River, Que., and provide light and power for some sixteen municipalities extending from Rimouski to Matane. The initial development will be 3,000 hp. from a head of 120 ft. Work will be commenced immediately and it is expected that the development will be completed before the end of the year.

EQUIPMENT AND MATERIALS

Special Refuse Collection Bodies on New York's 128 New Trucks

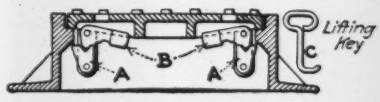
Power dumping bodies of 6 cu.yd. capacity, developed especially for refuse collection under conditions existing in New York, will be used on all but eight of the 128 five-ton motor trucks which have just been purchased by the City of New York from the White Co., Cleveland, following a previous order for 212 trucks of the same make. These are claimed to be the two largest orders for motor trucks every placed by a municipality and give New York the largest fleet of standardized heavy-duty trucks. Specifications required bidders to produce verified records showing at least 100 heavy-duty trucks which have covered more than 75,000 miles. This requirement was met by the White Co., which qualified in this respect two years ago.

One hundred and twenty of the new trucks will be equipped with power dumping bodies and used for all phases of street cleaning work, including the removal of ashes, garbage and snow. Six trucks will be provided with winches and two will be equipped with apparatus for handling wrecks. To protect the city against the blocking of thoroughfares by heavy snowfalls, such as happened two years ago when New York traffic was paralyzed for days, provision is made for attaching snow plows to the fronts of the trucks.



Locking Manhole Device

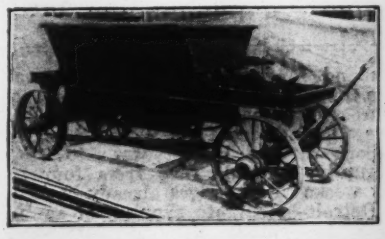
To prevent accidents caused by tipping manhole covers, and resulting damage suits against municipalities, a frame and cover with an automatic



locking device, illustrated herewith, have been developed by the Chalmers Pump & Manufacturing Co., Lima, Ohio. The locking is automatic when the cover is placed in the frame. To unlock, two keys, C, are inserted through slots in the cover, given a quarter turn to engage levers, B, which release the latches, A, during the process of lifting the cover. The locking mechanism is so designed that the parts never become disengaged without the use of the lifting keys.

Two New Models of Trailer Have Roller Bearing Hubs

Two models of trailers for contractor's use, one with a flat platform body and the other with a bottom-dump body, are announced by the Easton Car & Construction Co., Easton, Penn. The



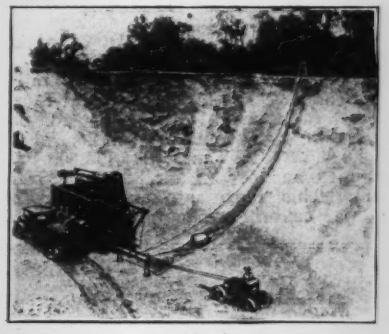
bottom-dump type illustrated herewith is of all-metal construction and has a capacity of 40 cu.ft., although other sizes are built. The platform type is designed for loads of 2 or 3 tons. Both models are equipped with 30-in. wheels with wire steel tires and roller-bearing hubs. The trailers are fitted with couplings to permit of operation singly or in trains. The wheels cut under the body making possible a very short turning radius.

Portable Power Drag Scraper

To meet the requirements of the man who is handling material in a small way, especially the county road commissioner or contractor who wishes to utilize a local sand and gravel deposit, a new type of portable power drag scraper outfit has been placed on the market by Sauerman Bros., Chicago.

The new outfits are equipped with Crescent type power scrapers, designed especially for use with a light power unit as they are easy to pull and travel straight. The double-drum hoist is furnished with gasoline engine, direct-connected, or is arranged for belt drive from a tractor or other motive power. The truck frame is of heavy steel-channel construction mounted on broad-tread, grooved steel wheels with steel axles.

One man handles the entire operation through two levers placed side by side, loading and dumping being accomplished automatically. The front drum of the hoist operates the load cable which leads through a sheave from the drum to the bridle chains on the front of the scraper. The pull-back cable leads from the rear drum through



another sheave out to a guide block at the far end of the excavation, and then is attached to the rear bridle chains of the scraper.

The entire outfit, it is claimed, can be made ready to operate in less than an hour after arriving at a new location.

Out-of-the-Ordinary Trade Publications

Gypsum Plaster — THE UNITED STATES GYPSUM CO., Chicago, in a 32-p. pocket-size booklet, just published, explains how to get the best results from the use of gypsum plaster. The text describes the action of all gypsum plasters, explains how plaster troubles may be prevented, and suggests ways of discovering causes of troubles and remedies. A valuable feature of the booklet is a tabulated list of troubles and how to prevent them. The hints in the tabulation are further elaborated in the text pages. The booklet is a useful, practical guide on improving the character of all types of work in which gypsum plaster is employed.

Roofing Materials — GARDINER & LEWIS, INC., New York and Chicago, have issued a 16-page booklet on Karnak roofing materials, with particular reference to the properties of fluxed asphalts, lake asphalts, and unfluxed asphalts refined from asphaltic petroleum. Physical properties desired in a satisfactory roofing material are summarized and there is included a reprint of the American Concrete Institute's Committee Report on Reinforced Concrete Highway Bridges and Culverts, dealing with standard tests for bituminous materials. Notes are also given regarding the selection of the proper type of membrane for waterproofing purposes.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in Nine Cities

Car Rather Than Coal Shortage Retards Mill Shipments—Steel Output Down 10 Per Cent—Lumber at Normal

Steel—August output of steel ingots totaled 2,214,582 tons, a drop of over 10 per cent from the preceding month. Production was the lowest since February, when the output was 1,745,022 tons. Compared with the May total of 2,711,141 tons, the highest for the year, August shows a falling off of over 18 per cent. The total for the eight months just past, stands at 18,201,072 tons as against 16,826,946 tons for the whole of 1921. August operations proceeded at an average rate of about 66 per cent of capacity.

Lumber—An average of 381 mills reporting weekly to the National Lumber Manufacturers' Association, for the four weeks ending Aug. 26, show 939,029,583 ft. cut, 834,793,508 ft. shipped and orders for 887,059,993 ft. b.m. This represents an increase of 11 per cent in production, 3 per cent in shipments and 15 per cent in orders over the four weeks of July. Latest reports show production normal; orders 8 per cent and shipments 12 per cent, below normal.

Cement—Output during July totaled 11,557,000 bbl., as against 11,245,000 for June, an increase of 312,000 bbl., according to the Geological Survey. Shipments increased 380,000 leaving a reserve of 8,424,000 bbl. on Aug. 1, 1922, a decrease of 2,294,000 bbl. from the preceding month.

Brick—Latest information as of Aug. 1, received from ninety-four firms reporting to the Common Brick Manufacturers' Association of America, show slightly less than 112,000,000 brick burned as against 106,475,000 produced the month before by ninety-five manufacturers. Of the ten plants closed down, four lacked fuel. In addition, five more plants reported that they must close shortly for the same reason. One plant among those shut down could make no more shipments because of car shortage. While coal is being mined in many districts, transportation to the brickyards is far from satisfactory.

San Francisco—Large stocks of cement, brick and lumber; plenty of sewer pipe, road oils, asphalt and hollow tile. Dealers' stocks of reinforcing bars, manila rope and galvanized steel sheets in good condition; fair supplies of track materials, metal lath, triangle mesh, steel shapes, blue annealed and black steel sheets and wire nails. Stocks of steel rivets and cut nails low. Large stocks of lime at warehouses and nearby kilns. Railroad ties purchased on order only. Cast iron pipe shipped from the East.

Denver—Local lumber stocks ample for current needs but mill shipments hampered by car shortage. About ten cars of asphalt on sidings and 2,000,000 brick on hand in local plants.

Minneapolis—Lumber stocks about normal for this season, with light demand. Brisk buying, at outbreak of the rail strike, has begun to subside. Brick and cement shortage has lowered demand for lumber. Brick, tile and cement stocks reported low; yards and warehouses about stripped and orders are filled direct from cars. Dealers report that if buying were to stop abruptly, it would take from four to six weeks to fill orders already booked.

Detroit—Moderate supplies of sewer pipe in yards; demand somewhat smaller than earlier in the season. Scarcity of cement. Majority of Michigan mills closed down because of lack of fuel. Contractors refusing to bid on some jobs because of uncertainty of cement supply and high prices of available quantities. Lime supply not seriously affected by car shortage. No delays in brick deliveries from yards, but hollow tile requires several days. Moderate retail stocks of lumber and sufficient asphalt to meet demands.

New Orleans—Ample dealers' stocks of pine lumber; but mills refusing orders on account of car shortage. Open cars, commonly used for transporting lumber, ordered to mines to relieve coal shortage. Shortage of crushed stone, asphalt and 36 in. sewer pipe. Small stocks of gelatin dynamite; no black powder.

Atlanta—Plenty of lumber and common brick; large supplies of asphalt. Two carloads of structural steel on sidings; twenty cars of cement and thirty cars of lime. Deliveries on sewer pipe in 24 to 36 hr.; hollow tile, five to six days. Some difficulty being encountered in making deliveries on account of car shortage.

Philadelphia—Sewer pipe stocks entirely used up in face of greater demand than at any time this year. Cement stocks depleted; deliveries about one-half of normal. Lime demand far in excess of supply. Brick shortage continues. Growing scarcity of all grades of lumber in dealers' yards. Plenty of explosives and manila rope.

Montreal—Ample supplies of all construction materials. Especially large retail stocks of lumber. Deliveries, however, on common brick take three days; hollow tile two days.

New York—Plenty of sewer pipe in sizes above 6 in. Ample stocks of common lime. Brick shortage alleviated by slight falling off in demand. No shortage of structural steel in dealers' warehouses.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (cement, Denver, 10,000 bbl.); time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta 24 @ 36 hr.); and stocks on hand in general terms, example: (common brick, Philadelphia, shortage.)

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	Philadelphia	Montreal	New York
Sewer pipe	Plenty	Del. 24 hr. local plant.		Sufficient	Stocks low	Del. in 24 @ 36 hr.	Entirely used up	Ample	Plenty in sizes above 6-in.
Cement	Large stocks	10,000 bbl.	Stocks low	Scarcity Mills closed.	Enough	20 cars	Depleted	Plenty	No shortage.
Lime	Big reserve	Plenty		Plenty		30 cars	Demand ahead of supply.	Enough	Plenty of common.
Common brick	Well supplied	2,000,000	Yards stripped	Moderate supply	No shortage	Plenty	Shortage	Sufficient; del. 3 days.	Shortage slightly relieved.
Hollow tile	Plenty	Sufficient	Scarcity	Stocks up to normal.		Del. 5 @ 6 days.		Enough; del. 2 days.	Shipped by water.
Lumber	Heavily stocked.	Dealers stocks ample.	Normal	Moderate retail stocks.	Ample; mill shipments delayed	Plenty at present.	Stocks low	Large retail stocks.	Mill del. slow.
Asphalt	Unlimited supplies.	10 cars.		Sufficient to meet demand		Large supplies	Heavy reserves		Refineries well stocked.
Structural steel	Fair					2 cars.		Warehouse stocks, good.	Enough in warehouses.

How New Tariff Law Will Affect Building Materials

(Washington Correspondence)

The new tariff law will provide heavy increases on structural steel over the existing duties if Congress accepts the conference report which was submitted to the House Sept. 12, as it probably will do. The Senate rates on building materials generally were accepted by the conferees.

Structural iron and steel, unassembled, carries a duty of ⅛c. per lb., and if machined, drilled or otherwise advanced beyond hammering, rolling or casting, the duty is 20 per cent; while sashes, frames and building forms bear a duty of 25 per cent. The rate under the existing law is 10 per cent on all these.

Shingles remain on the free list, where they were placed by the Senate. House conferees made a vigorous contest for a 25c. duty but finally receded.

Building stone bears a duty of 50 per cent if hewn or dressed and a rate of 15c. per cu.ft. if not dressed or hewn.

Common brick and cement remain on the free list.

Street Paving Cheaper In Dayton, Ohio

Figures Given On Macadam, Concrete, Asphalt, Brick, Wood Blocks, Durax and Other Materials

By Ivan E. Houk
City Engineer, Dayton, Ohio

STREETS are being paved in Dayton this year at costs considerably lower than last year or than at any time since before the war. Asphalt pavements with 3-in. of asphalt are being laid for $3.14 per sq.yd. as against $3.99 last year, brick pavements at $3.37 as against $4.01 and reinforced concrete, 8 in. thick in the center of the street and 5 in. at the gutters, for $2.24 as against $2.40. Concrete alley pavements are being laid at a cost of from $2.09 to $2.50 per sq.yd. as against $2.24 to $3.73 last year. These prices include grading but do not include curb or combined cement curb and gutter. However, in no instance in the street paving work did the grading amount to much more than removing enough material to make room for the pavement, but some of the prices for alley pavements are high due to unusual amounts of grading.

Concrete streets and alleys in Dayton are reinforced with a wire mesh reinforcing having a weight of not less than 28 lb. per 100 sq.ft. Alleys have a uniform thickness of 6 in., the subgrade being shaped to correspond with the surface of the pavement, that is, with the center 4 in. lower than the edges so that the water will drain down the center. Other types of street pavements, such as brick, wood block, durax and asphalt, are laid on a 6-in. concrete base covered with a suitable cushion. Wood block is always laid on a 6-in. concrete base covered with a 1:4 mortar cushion, ½ in. thick. The other types of permanent pavements are laid on a 1-in. cushion of either sand or mortar. A soft filler is used in all cases; sometimes a straight asphalt, sometimes a mastic made by mixing hot asphalt or pitch with equal proportions of heated sand. A 1:3:6 mixture is used in the concrete foundations, and a 1:2:3 mixture in the concrete streets and alleys. Separated and washed materials are specified in all cases. Standard wire-cut paving blocks, 8½ in. long, 3 in. wide, and 4 in. deep, are used on the brick streets. Wood block must average 8 in. in length, although they may vary from 6 to 10 in. and must be 3½ in. deep and from 3 to 4 in. wide. Two kinds of oil are specified for the wood block, oil "A", a distillate obtained wholly from coal tar and oil "B", a more volatile oil produced from coal gas or coke oven tar.

The accompanying table gives the low prices bid on the street pavements completed in Dayton since Jan. 1 of this year or now under contract. Contracts have been let to the low bidders so far. The prices given for wood block pavements are for oil "A". Prices for oil "B" were about 20c. per square yard lower. Bids for brick pavements on a mortar cushion were generally from 5 to 20c. per square yard higher than for a sand cushion. Bids on oil asphalt were about 20c. per square yard lower than on lake asphalt. The streets included in the table involve a total of about 65,700 sq.yd. The total cost of the work, including storm sewers, manholes, catch basins, curb and gutter and other incidentals, will be about $325,000. Alleys paved thus far this year, or now under contract, involve a total of 14,555 sq.yd. and a cost of approximately $37,700.

Prices for combined cement curb and gutter are running about 70c. per lineal foot for the straight sections and about 90c. for the circular, while prices for curb alone are about 10c. per running foot lower. Straight granite curb is costing $1.75 per lineal foot, and circular granite, $2.50, although somewhat lower prices were bid by contractors who were not low on the main items. The prices for cement curb and gutter are about 30 per cent lower than last year; those for granite curb have not changed much.

Some paving materials are cheaper than last year; others are practically the same or slightly higher. This year cement has been delivered f.o.b. cars, Dayton, at prices varying from $2.68 to $2.96 per barrel, whereas in the spring of 1921 the price was $3.51. Brick is about the same as last year; contractors are now paying about $34 per thousand, f.o.b. cars, Dayton, as against $36 last year. Durax block is now being delivered, f.o.b. cars, Dayton, at $2 per square yard. Last year the price was about 10 per cent lower. Wood block, oil "A," is being delivered at about $2 per square yard, whereas last year the price was 30 per cent higher. Sand and gravel are delivered on the job at $1.75 per cubic yard,

(Concluded on p. 460)

LOW UNIT PRICES BID ON DAYTON STREET PAVING WORK COMPLETED THIS SEASON OR NOW UNDER CONTRACT

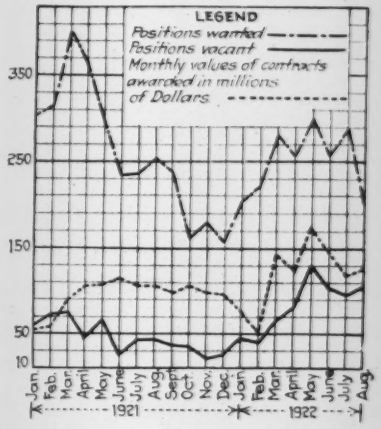
Street	Sq.Yd.	Price Per Square Yard Laid—Mac.*	Conc.	Asp.	Brick	Wood	Bl. Durax	Remarks
Belmonte Park N.	2,125	....	....	....	$3.99	....	....	Mortar cushion, asphalt filler.
Cambridge	2,350	....	....	$3.45	....	....	....	City to lay asp. at $1.40 per yd.
Dakota	3,605	....	....	....	3.58	....	....	Mortar cushion, mastic filler.
Five Oaks	3,525	....	....	....	3.81	....	....	Mortar cushion, asphalt filler.
Garland	4,300	....	$2.34	....	....	....	....	1:2:3 mixture, std. section.
Johnson	5,750	....	....	....	3.74	....	....	Mortar cushion, asphalt filler.
Jefferson St. Culvert	900	....	1.60	....	....	....	....	1:3:6 base or asphalt top to be laid by the city.
Kenwood, Section 1	5,050	....	2.24	....	....	....	....	1:2:3, std. section**
Kenwood, Section 2	2,300	....	2.40	....	....	....	....	1:2:3, std. section.
Louie	4,680	....	....	....	3.79	....	....	Mortar cushion, asphalt filler.
Norwood	930	....	....	....	3.79	....	....	Mortar cushion, asphalt filler.
North Main	9,325	....	....	....	....	$4.68***	....	On shoulders.
North Main	4,950	....	....	....	3.83	....	....	In car tracks. Mortar cushion, asphalt filler
North Main	7,395	....	....	3.95	....	....	....	Lake asp. Alternate plan for shoulders.
South Main	3,600	....	....	....	....	4.64	....	On shoulders.
South Main	750	....	....	....	4.10	....	....	In car tracks. Mortar cushion, asphalt filler
Orth	1,055	....	....	3.14	....	....	....	City to lay asp. at $1.40 per yd.
Springfield, Sec. 1	4,987	....	....	2.85	....	....	....	Alternate plan.
Springfield, Sec. 1	5,397	....	....	....	3.37***	....	....	Sand cushion, asphalt filler.
Springfield, Sec. 1	5,485	....	2.27	....	....	....	....	1:2:3, std. section.
Springfield, Sec. 2	2,500	$2.40	....	....	....	....	....	Temporary pavement.
Third St. Bridge	1,390	....	....	....	3.47	....	....	On shoulders. Sand cushion, asphalt filler.
Third St. Bridge	1,190	....	....	....	....	....	$4.78	In car tracks. Sand cushion, mastic filler.

* 2½-in. bituminous macadam top on 6-in. water bound macadam base. ** $6,400 sewer job in this contract. *** Contract let on this bid.

When Men Look for Jobs and Jobs for Men

Number of Construction Positions Wanted and Vacant Compared with the Volume of Contracts

The chart comparing monthly values of contracts awarded with the number of engineering-construction "positions wanted" and "positions vacant" in 1921 and 1922, as published in *Engineering News-Record*, shows an interesting relationship. To make the curves more



nearly comparable all monthly figures are held to a four-issue-per month basis. That is, where there are five issues of the *News-Record* in a month, the total dollars or positions were divided by five and then multiplied by four.

With value of contracts let increasing each month from March to June of 1921, inclusive, men advertised in numbers in the first month, thereafter in sharply decreasing volume until June. In July the contract volume fell off a little, while "positions wanted" rose in about the same proportion. August contracts were slightly lower than the July total, and advertisements for positions mounted rather sharply.

From August to the end of the year the contract volume remained fairly steady, while the minimum number of positions were sought, indicating that contractors had completed their organizations, and that the majority of engineers were employed.

In the first half of 1922 there are

three peaks in the "positions wanted" curve. These peaks, about on a level, occurred in March, May and July. These are accounted for by the powerful upward thrust of the contracts-awarded curve, which attained the maximum in May as against March in the previous year.

"Positions vacant" were fewest during the period when contracts were being awarded at approximately the same rate, May to December, 1921. Then with the heavy increase in contracts, an increasing number of openings were advertised, the peak occurring in May, 1922, when the maximum volume of contracts was awarded. In August, with fewer men advertising for positions, the announcement of positions vacant increased.

Street Paving Cheaper in Dayton, Ohio

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practically the same as last year. Abundant deposits of sand and gravel are found in the Miami Valley around Dayton, some pits being within the city limits. Common labor this year has been available at 35 or 40c. per hour, about 5c. more than last year.

The real reason pavements are being laid so much cheaper this year than last is that we have had real competition among the contractors. The beginning of the season found several large contractors completely out of work, so that they were willing to take contracts with a small margin of profit in order to keep their men together and keep their equipment working.

Dayton's paving work is beginning to feel the effects of the coal and railroad strikes, particularly the brick contracts. Probably some of the jobs now under way will not be completed until next year owing to brick shortage.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 7; the next, on October 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+$3.04	$3.65	$4.20	$2.92½	$3.05	+$3.80	$3.25	$3.75	$3.75
Structural rivets, 100 lb.	3.85	4.35	6.00	3.35	3.52½	4.80	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb.	+2.94	3.50	3.50	2.82½	2.95	+3.97½	3.00	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	57%	61.15%	45%	59½%	58.9-5%	43%	45.7@49.1%	50%	30.00
Cast-iron pipe, 6 in. and over, ton	+55.30	+49.50	51.50	+46.86	52.00	+60.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl.	+2.85@3.00	2.50	2.25	+2.20	2.39	2.85	2.71	2.90	2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	2.00	1.75	1.75	2.25	1.00	1.50
Sand, cu.yd.	1.00	1.15	2.25	2.00	1.00	0.75	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	1.65	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+55.00	40.00	40.00	+49.00	40.00	50.00	33.00	+24.50	50.00
Lime, finishing, hydrated, ton	15.80@16.17	−22.50	25 00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	−1.75	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	−21.30	11.00	10.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.09	−.065	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	.0776	.115	.0808	.09	−.065	.108	.11	.09
Linseed oil, raw, 5 bbl. lots, gal.	.91	−.95	1.13	.99	1.00	1.12	1.04	.86	1.12
Common Labor:									
Common labor, union, hour	.60	35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.87 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

With the fuel situation greatly improved, production is rapidly increasing in the steel mills, in contrast with the general slump during August. Steel shapes quoted by leading interest at minimum of $2 per 100 lb.; $2.50 obtaining on current trading, for prompt deliveries. Reinforcing bars, $1.90@$2.25, f.o.b. Pittsburgh; quotation only nominal owing to scarcity of material. Mill shipments, New York, of reinforcing bars, quoted at $2.24@$2.59, or mill price plus freight of 34c. per 100 lb.; shapes, $2.34@$2.85. Mill shipments, f.o.b. Denver, quoted at $3.52½ on bars; $3.97½, at warehouse, as against $3.87½, one week ago. Rise of 11c. per 100 lb. on structurals in New York during last two weeks.

Cast-iron pipe, 6-in., up $1.66 in Chicago, $2 in New York and $3 per ton in Denver, following coke and pig-iron scarcity.

Improvement in handling shipments, on the part of Southern railroads, is expected to increase the volume of pine lumber movements from mills east of the Mississippi, in the near future. However, structural timbers, long-leaf yellow pine, are quoted at an advance of $2 in New York and Chicago with Douglas fir up $1.50 per M. ft. b.m., in Seattle.

The only declines for the week occurred in brick, lime and hollow tile; indicating a let up in the coal shortage as well as a slight falling off in demand. Brick quoted at $18 per M. wholesale, alongside dock New York, as against $18@$20, last week. Hydrated finishing lime down 50c. per ton and common lump, 5c. per bbl. in Atlanta. Hollow tile cheaper in Denver. Montreal reports brick deliveries greatly delayed and labor scarce.